BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

PRINCIPAL BENCH, NEW DELHI

INTERIM APPLICATION NO. 174 OF 2020

IN

EXECUTION APPLICATION NO. 5 OF 2018 (THC)

IN

ORIGINAL APPLICATION NO. 40 OF 2014

IN THE MATTER OF:

Charudatt Pandurang Koli & Ors. …Applicants

Versus

M/s Sealord Containers Ltd. & Ors. …Respondents

ADDITIONAL AFFIDAVIT BY RESPONDENT NO. 2 IN SUPPORT OF THE PRAYER MADE IN I.A. NO. 174/2020

INDEX

27.06.2020
Delhi

Filed by:

LIZ MATHEW
Advocate for Respondent No. 2

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ADDITTIONAL AFFIDAVIT BY RESPONDENT NO. 2 IN SUPPORT OF THE PRAYER MADE IN THE PRESENT I.A. NO. 174 / 2020

I,Shashikant Deshmukh, age about 43 years having my office at 1202,Tower B, Peninsula Business Park, G.K. Marg, Lower Parel (W), Mumbai – 400 013, do hereby solemnly affirm and state as under:-

1. That I, the Deponent,ampresently working as Head (Legal) with Respondent No.2. In my official capacity, I am the authorised signatory of Respondent No. 2, and I am fully conversant with the facts and proceedings of the present case, and as such,I am competent to depose in the matter and file the present affidavit.
2. In the present proceedings before this Hon'ble Tribunal, primarily there are 4 Respondents. They are:-

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(i) Bharat Petroleum Corporation Limited (BPCL);

(ii) Hindustan Petroleum Corporation Limited (HPCL);

(iii) Aegis Logistics Ltd.; and

(iv) Sea Lord Containers Ltd.

3. This Hon'ble Tribunal had appointed a Joint Committee. This Joint Committee had submitted a Report to this Hon'ble Tribunal. The said Joint Committee, in its Report, had confirmed all the safety measures which had already been deployed by the parties including M/s Aegis Logistics Ltd. and M/s Sea Lord Containers Ltd. who are importing the chemicals, which require storage at theirterminal upon their import and till the time they get transported to the purchasers / consumers. These two companies are not undertaking any production / manufacture of any product utilising the chemicals in question imported by them.

4. One of the suggestions given by the Joint Committee in the case of M/s Aegis Logistics Ltd. and M/s Sea Lord Containers Ltd. – was to substitute the Fixed Roof on the storage tanks by Floating Roof. This suggestion was in addition to the finding of compliance with all the Control Measures employed by these two companies in their respective plants. This was to further strengthen the efficiency of the Control Measures which were already in existence and meeting the requirements.

5. It is also a matter of record that both these companies had carried out the suggestions made by the Joint Committee including by providing Floating Roofs in the Tanks and have suitably informed the authorities in this behalf.

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6. Having regard to the level of handling of the chemicals in question for imports, storage before its transportation to the destination of the purchasers / customers, it has been the submission on behalf of both these companies that they are not causing any damage to the environment.

7. That in accordance with the order passed by this Hon'ble Tribunal on 15.07.2019, a Report dated 18.03.2020 by the Central Pollution Control Board (hereinafter referred to as "**CPCB**") has stood placed on record. A copy of the CPCB Report dated March 18, 2020 is annexed to the captioned application being I.A. No. 174 / 2020 as Annexure R2/24 at page 443.

8. The perusal of the Report reveals that CPCB had requested the National Environmental Engineering Institute (hereinafter referred to as "**NEERI**")to undertake the exercise for finding out the damage, if any, to the Environment and computation in that regard. It is most humbly submitted that any such exercise by the CPCB or by NEERI on the request of CPCB has to be in accordance with prescribed / laid down norms – which are transparent, non-arbitrary and are reasonable and justified. In any case, there cannot be any omission / denial to not to disclose / share the objective basis and methodology adopted by NEERI for undertaking any such exercise in terms of the order dated 15.07.2019 passed by this Hon'ble Tribunal.

9. The Report submitted by CPCB – which does not reveal the objective criteria / methodology adopted by NEERI had compelled the present Applicant to approach CPCB. In response to its

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endeavour, the Applicant herein has stood informed by CPCB that the CPCB is not in the know of the criteria / methodology adopted by NEERI in coming to its conclusions in the Report dated 18.03.2020, made available to the Applicant only in May 2020. The attention of this Hon'ble Tribunal is invited to the contents of the letter dated 25.05.2020 **[Pg. 473 of IA 174 / 2020]** by the Applicant to the CPCB as well as the response letter of the CPCB dated 25.05.2020 **[Pg. 474 of IA 174 / 2020]**.

10. As mentioned in the present I.A. and also briefly set out hereinbelow, there are fundamental omissions / errors on account of non-disclosure of the criteria / methodology adopted by NEERI in coming to the conclusions as mentioned in the Report dated 18.03.2020 submitted by the CPCB. It, therefore, had created an imminent necessity / compulsion for the Applicant to approach this Hon'ble Tribunal through the present Application and where the prayers have been made at Pg. 16 thereof.

11. After the filing of the present Application, another communication / Report dated 12.06.2020 by the Institute of Chemical Technology (hereinafter referred to as "**ICT**") has become available and which, in the most humble submission of the Applicant, is relevant for the consideration of this Hon'ble Tribunal. The primary objective of the present Additional Affidavit on behalf of the Applicant is to also place on record the copy of the said Report dated 12.06.2020 of the ICT. The present Additional Affidavit is in continuation of the contents of I.A. No. 174 / 2020 and the contents of this Affidavit may kindly be treated as an integral part of I.A. No. 174 / 2020.

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12. That in the present Application, Respondent No.2 has, inter alia, placed on record that the report of CPCB is bereft of essential details, especially the assumptions / calculations / criteria / methodology based on which CPCB has arrived at the figures in its Report, as well as the dispersion modelling [which is the methodology used to determine the amount of VOCs which are dispersed in the air] which has been used by CPCB / NEERI. Respondent No.2 has also placed on record the communications exchanged with CPCB, wherein CPCB has stated that it is not even aware of the manner in which the dispersion modelling has been conducted by NEERI. Respondent No.2 has, inter alia, prayed for a direction to CPCB to provide the complete copy of the Report alongwith all assumptions, calculations, supporting and other documents / information used by NEERI / CPCB for arriving at the Report, including the full dispersion model alongwith assumptions, workings and results. Respondent No.2 has prayed for the said details to be made available, so that it can respond to the Report of CPCB which is, *ex-facie*, flawed and erroneous, on account of incorrect and inconsistent criteria / methodology having been adopted by CPCB.

13. It is most humbly submitted that allowing the present Application by this Hon'ble Tribunal shall enable the Applicant to file itsdetailed submissions in response to the CPCB Report. Upon receipt of the all assumptions/calculations on the basis of which the CPCB Report has beenprepared, for the reasons and groundsas more particularly mentioned in the captioned

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application, the Applicant would get the required opportunity to submit its response in a efficient and meaningful manner for consideration of this Hon'ble Tribunal.

14. That when the bonafide endeavours being made by the Applicant for deciphering the objective criteria / methodology adopted by CPCB / NEERI for undertaking the exercise in terms of order dated 15.07.2019 passed by this Hon'ble Tribunal – were not getting responded to, Respondent Nos. 1 and 2 hadrequested another reputed institution viz. the ICT to undertake a similar exercise using the same data as provided to NEERI and in accordance with the prescribed / adopted norms which are fair, justified and reasonable.

15. The ICT has, inter alia, prepared 3 Reports being:-

   a. Report No.1 dated 23.03.2020 [Pg. 364 – 441] of I.A. No. 174 of 2020. A copy of the said Report is also annexed herewith as **ANNEXURE R2/1 [Pg.** 15 **to Pg.** 92 **]** for the convenience of this Hon'ble Tribunal to peruse these documents at one place.

   b. Report No.2 dated 30.04.2020 [Pg. 465 – 470] of I.A. No. 174 of 2020. A copy of the said Report is also annexed herewith as **ANNEXURE R2/2[Pg.** 93 **to Pg.** 98 **]** for the convenience of this Hon'ble Tribunal to peruse these documents at one place.

   c. Report No.3 dated 12.06.2020. A copy of the said Report is also annexed herewith as **ANNEXURE R2/3 [Pg.** 99 **to Pg.** 152 **]**.

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INSTITUTE OF CHEMICAL TECHNOLOGY REPORT

DT. 23.03.2020

16. The above-mentioned Report of ICT makes it clear that in order to ascertain whether the vapour emissions from Sealord or Aegis terminals are harmful to human population, it was necessary to carry out the dispersion modelling of the vapour emissions and compare the results with Indian and international exposure limits with respect to health effects due to inhalation exposure. ICT carried out the Dispersion Modelling and computed the resultant vapour concentration in the residential areas. For carrying out its study, it used the Ambient Air, Permissible Exposure and Health Standards contained in:-

    a. Indian Factories Act, 1948;
    b. USA Environmental Protection Agency (EPA) RfC;
    c. USA – Occupational Safety and Health Administration's (OSHA) – Permissible Exposure Limit (PEL);
    d. Canada, Ministry of Environment and Climate Change – Ambient Air Quality Criteria (AAQC).

17. After carrying out this most critical and integral / inseparable prescription of Dispersion Modelling – as pointed out at Pg. 355-357 by M/s Aegis Logistics Ltd.,the ICT concluded at Pg. 370 [in the first Report dated 23.03.2020 from Pg. 364 – 370 of the present Application] that there is unlikely to be any harmful effect on human health of surrounding population in the area on account of air emissions of Volatile products from the Aegis and Sea Lord

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Terminals. This aspect is not at all even considered and has been ostensibly overlooked / omitted in the Report dated 18.03.2020 of CPCB. The requisite application thereof would clearly demonstrate and establish that the conclusions drawn in the Report dated 18.03.2020 are entirely unsustainable.

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DT. 30.04.2020

18. Similarly, as another example, the perusal of Table 1.2 @Pg.449 of IA No. 174 / 2020 reveals that the Figure of 376 kg/day of VOC emissions in relation to Respondent No.2 – M/s Aegis Logistics – if the mandatory norms of the methodology under USEPA AP-42 are followed, this figure of 376 kg/day will come down to approximately 9.5 kg/day. This outcome shall be placed before this Hon'ble Tribunal with reference to Pg. 449, 467 and Pg. 474 of the present I.A. Upon coming to the correct figure of 9.5 kg/day [instead of the figure of 376 kg/day] in relation to M/s Aegis shall also render the conclusions in the Report dated 18.03.2020 as entirely unsustainable.

INSTITUTE OF CHEMICAL TECHNOLOGY REPORT

DT. 12.06.2020

19. The ICT has prepared a report titled "*VOC Estimation, Dispersion Modeling and Environmental Impact Assessment of Aegis Logistics Ltd, Chemical Storage Terminal*"dated June 12, 2020 ("**ICT Report**"), which determines the following: a) the quantity of

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VOC's emitted; b) whether the VOC emissions were in such quantities and concentrations so to as to beharmful to the environment and pose a threat to human health; and c) review of the emissions estimates of VOCs in the CPCB Report and compare the results with ICTsfindings.

20. This ICT Report dated 12.06.2020 *inter alia* states that:

a. It estimates the volume of HAP and VOC (as specifiedby US EPA and the Ministry of Environment, Forest and Climate Change, Government of India) emissions from the vertical fixed roof tanks, the product gantry &effluent treatment plant, models their dispersion & resultant concentrations, and compares themto US EPA reference concentrations for health impacts as shown by CPCB in Table 2.2 in the CPCB Report;

b. The input data provided by Respondent No. 2 is identical to that provided to NEERI. AP-42 has been usedto estimate the daily VOC emissions after control measures in line with the protocol agreed withthe CPCB. Thereafter, dispersion modeling carried out for each product emitted to measurethe predicted concentrations of the relevant substance and compared to US EPA referenceconcentrations to determine if there would be any adverse health effects;

c. The calculations contained in the CPCB Report are different than those calculated by ICT. The main difference appears because: a) no adjustment has been made for

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controlmeasures implemented in the tanks; and b) that all products, irrespective of whether they areclassified as VOC's or HAP's have been considered including several products not on the list ofproducts stored or handled by Respondent No. 2. No calculations have been shown for the concentrationor dispersion of the VOC's or HAPS for ICTto comment on the environmental impact;

d. **It is imperative to receive from CPCB, a full set of assumptions anddispersion calculations for each of the products so that ICT may be able to evaluate and comment onany differences between ICTs calculations and those performedby NEERI**; (emphasis supplied)

e. None of the products handled by Respondent No. 2 which are consideredas Hazardous Air Pollutants by US EPA are currently classified as carcinogenic and the vapourconcentrations of these products in the complainant's resident areas would be significantly below the RfC of US EPA;

f. The Consent to Operate granted to Respondent No. 2 has been modified by the MPCB pursuant to the judgement passed by the Hon'ble Tribunal on December 15, 2015 (in O. A. No. 40 of 2014) and which specifies the application of GSR 820(E). The GSR 820(E) lists theVOC's which are to be controlled;

g. All estimations done as per AP-42, before and after control measures installed at the terminal of Respondent No. 2 AP-

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42 default efficiency benchmarks for control measures. The emission quantity of products classified asHAP as per US EPA or as VOC as per MoEF & CC GSR 820(E) from vertical fixed tanks, productgantry and ETP are set out as under along with the figures contained in the CPCB Report for ease of reference:-

	Regulatory Standard		
Source of Emission in Kg/Day per AP 42	US EPA	GSR 820 (E)	CPCB Report
Tanks	2.84	6.00	369
ETP	0.16	0.16	2.61
Product Gantry	1.01	1.28	4.39
Total	4.01	7.44	376

h. In order to ascertain whether the HAP or VOC emissions of Respondent No. 2 pose anyenvironmental risk to the nearby population, ICT carried out dispersion modeling for each productstored in vertical fixed roof tanks, loaded at the Product Gantry or emitted from the ETP using fundamentaldispersion equations in the methodology prescribed in C.S Rao's *Environmental PollutionControl Engineering",3rd Edition* incorporating all key variables with certain assumptions basedon the factual data provided by

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Respondent No. 2. The summary of resultantconcentrations at the location of theApplicants of products classified as HAP by the US EPA or as VOC's by GSR 820(E) iscompared with the US EPA health effects database for chronic inhalation in the table below since there are no comparable Indian reference standards for health effects from chronic inhalation; and

i. The ICT Report concludes that:

   i. The emission of VOCs as defined per US EPA from the storage tanks of Respondent No. 2, product gantry and ETP are in the range of 4 Kg per day (and which is negligible as compared to the figure of 376 Kg per day as stated in the CPCB Report);

   ii. If defined as per MoEF & CC, the VOC emissions are 7.44 Kg per day;

   iii. The dispersion modelling of each VOC was carried out and compared with US EPA health reference standards for inhalation on a chronic basis and found to have negligible environmental or health impact whether Indian or US EPA list of VOC is applied; and

   iv. The calculation of monetary damages does not appear to be relevant since the emissions of VOC's appear to be within standards specified in GSR 820 (E) and the concentrations in thecomplainant area are negligible.

21. That Respondent No. 2 requestedCPCB to provide a complete

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copy of the CPCB Report including all assumptions, calculations and details the dispersion model. However, as CPCB failed to provide the same, Respondent No. 2 was constrained to file I. A. No. 174 of 2020 for seeking appropriate directions from thisHon'ble Tribunal to CPCB for providing a complete copy of the CPCB Report alongwith all assumptions, calculations, supporting and such other documents/information used by NEERI/CPCB for arriving at the CPCB Report including full dispersion model alongwith assumptions, workings and results.

22. In view of the aforesaid, it is respectfully submitted that it is *ex-facie* clear that the CPCB Report is flawed, erroneous and once the assumptions / criteria / methodology adopted are disclosed – it would render the Report unsustainable. Without prejudice to the errors as mentioned above, unless assumptions, calculations of NEERI are provided to Respondent No.2, it will be impossible to effectively and entirely analyze and respond to the CPCB Report. This being so, it is necessary in the interest of justice, equity and good conscience that the reliefs as sought for in the captioned application be allowed. An order by this Hon'ble Tribunal for allowing the present Application shall enable the Applicant to furnish its response to the Report dated 18.03.2020 and shall also meet the ends of justice. The Applicant / Respondent No.2 prays accordingly.

AEGIS LOGISTICS LIMITED MUMBAI

Place: Mumbai

Date: June 27, 2020

DEPONENT

(Authorized Signatory of Respondent No. 2)

VERIFICATION

I, Shashikant Deshmukh, the Deponent herein, age:43 years, employed at the Mumbai office of Aegis Logistics Ltd. (Respondent No. 2), at 403, Peninsula Chambers, Peninsula Corporate Park, G. K. Marg, Lower Parel (W), Mumbai – 400 013, being the authorized signatory for Respondent No. 2 do hereby declare that what is stated here is true to the best of my knowledge and belief and nothing has been hidden.

Verified before me on this the 27th day of June, 2020 at Mumbai.

Place: Mumbai

Date: June 27, 2020

AEGIS LOGISTICS LIMITED * MUMBAI *

DEPONENT

(Authorized Signatory of

Respondent No. 2)

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Dr. Anand V. Patwardhan
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ANNEXURE R2/1

VOC Emission Inventory and Dispersion Modelling study in parallel to the study conducted by CPCB thru NEERI

A report prepared for

Aegis Logistics Ltd. and Sea Lord Containers Ltd.

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VOC EMISSION INVENTORY AND DISPERSION MODELING STUDY IN PARALLEL TO STUDY CONDUCTED BY CPCB THRU NEERI

STUDY REPORT ON VOC EMISSION CAUSING HEALTH IMPACTS ON SURROUNDING POPULATION IN RESPECT OF SEA LORD CONTAINERS LTD. & AEGIS LOGISTICS LTD., MAHUL, MUMBAI

Further to the emission inventory and dispersion modelling study carried out by us for Sea Lord & Aegis terminal for the period 2018-19, we have been engaged by them for the following:

(1) Carry out estimation/verification of emissions from the product storage tanks, tanker loading gantries and ETP (concurrent with the CPCB study thru NEERI).
(2) Carry out a dispersion modelling analysis of the emissions and compare the resultant vapour concentration to Indian and International (USA and Canada) permissible exposure limits with reference to health effects on the resident population in the vicinity.

As information provided by them, the list of products handled (concurrent with the CPCB study thru NEERI) is provided below:

Aegis Products Handled	
Volatile	**Non Volatile**
Methanol	Acetic Acid
Acetone	Dimethyl Formamide
Ethyl Acetate	LAB
Iso Propyl Alcohol	HSD
MEK	MEG
Ortho-xylene	Isononanol
Toluene	Propyl Heptanol
Ethanol	Styrene Monomer
VAM	Base Oil
Mixed Xylene	Alpha Olefin
Motor Spirit	Cyclohexanone
Butyl Acetate	n-Butanol
	Acetic Anhydride

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Sealord Products Handled	
Volatile	**Non Volatile**
Methanol	Caustic Soda
Ethanol	Base Oil
	LAB
	Styrene Monomer
	N-Paraffin

As informed by the Company, Benzene is not handled or stored at either terminal.

They have provided detailed information including storage and throughput of above products. This information is also provided to CPCB& NEERI.

The standard methodology for calculating emission losses from both fixed and internal floating roof tanks is US EPA AP-42 Chapter-7, and for tanker loading losses is US EPA AP-42 Chapter-5 and ETP tanks is US EPA AP-42 Chapter-7. Emissions have been calculated based on this standard and summarized them below. The Emission estimation Sheets are attached vide Appendix-1.

Furthermore, in order to ascertain whether the vapour emissions from Sealord or Aegis terminals are harmful to the human population in the complainant resident area, it was necessary to carry out dispersion modelling of the vapour emissions and compare the results with Indian and international exposure limits with respect to health effects due to inhalation exposure. We have carried out the dispersion modelling and the resultant vapour concentration in the Complainant resident areas, which are summarized below. The Dispersion Model calculations are attached vide Appendix-2.

Ambient Air, Permissible Exposure, and Health Standards used:

1. Indian Factories Act 1948: *Section 41F of Act (vide The Second Schedule) specify the maximum permissible threshold limits of exposure of chemical and toxic substances in work environment of any factory expressed as Time Weighted average Concentration (TWA) (8 hrs.).*
2. USA Environmental Protection Agency: RfC*: Inhalation reference concentration. It is an estimate of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.* Source: US EPA website.
3. USA- OSHA – PEL (Permissible Exposure Limit*) Occupational Safety and Health Administration's permissible exposure limit expressed as a time- weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.* Source: US EPA Website.
4. Canada, Ministry of Environment and Climate Change, (MoE & CC) –Ambient Air Quality Criteria-Health (AAQC) published on 10.12.2016 & updated on 30.04.2019: *An AAQC is a desirable concentration of a contaminant in air and is used to assess general air quality resulting from all sources of a contaminant to*

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air. AAQCs are most commonly used in environmental assessments, special studies using ambient air monitoring data, assessment of general air quality in a community and annual reporting on air quality across the province. AAQCs are set with different averaging times appropriate for the effect that they are intended to protect against. The effects considered may be ***health****, odour, vegetation, soiling, visibility, corrosion or other effects.* Source: Ontario Ministry of the Environment and Climate Change.

The findings based on the study thereof are presented below: The most stringent standard is highlighted and compared to the Vapour Concentration in the Complainant resident area.

Aegis Tank Vapour Emission

SR. NO.	Product	Vapour emission	Resultant Vapour concentration level in Complainant Resident area	Below/Above	Canada MoE & CC. AAQC (Health)	US EPA OSHA PEL	US EPA OSHA RfC	Factories Act, 1948 (India)
		Kg/day	μg/m^3		μg/m^3	μg/m^3	μg/m^3	μg/m^3
1	METHANOL	21.90	1.40	Below	4,000	260,000	10,000	260,000
2	ACETONE	97.13	6.44	Below	11,880	-	-	-
3	ETHYL ACETATE	11.26	0.74	Below	19,000 (Odour)	-	-	1,400,000
4	MEK	8.36	0.56	Below	1,000	590,000	1,000	590,000
5	ETHANOL	47.97	3.2	Below	19,000 (Odour)	-	-	1,900,000
6	VAM	11.90	0.79	Below	-	-	200	-
7	MOTOR SPIRIT	86.81	5.74	-	-	-	-	-
8	ACETIC ACID	43.18	2.84	Below	2,500 (Odour)	-	-	25,000
9	DIMETHYL FORMAMIDE	0.25	0.01	-	-	-	-	-
10	LAB	0.00	0.00	-	-	-	-	-
11	HSD	19.51	1.29	-	-	-	-	-
12	MEG	0.1	0.00	-	-	-	-	-
13	ISONONANOL	0.35	0.02	-	-	-	-	-
14	PROPYL HEPTANOL	0.00	0.00	-	-	-	-	-
15	STYRENE MONOMER	22.66	1.50	Below	400	425,000	1,000	215,000
16	BASE OIL	0.00	0.00	-	-	-	-	-
17	ACETIC ANHYDRIDE	0.180	0.01	-	-	-	-	-
18	ALPHA OLEFIN	0.03	0.00	-	-	-	-	-

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Sea Lord Tank Vapour Emission

SR. NO.	Product	Vapour emission	Resultant Vapour concentration level in Complainant Resident area	Below/Above	AAQC, MoECC. Canada (Health)	US EPA OSHA PEL	US EPA OSHA RfC	Factories Act, 1948 (India)
		Kg/day	µg/m^3		µg/m^3	µg/m^3	µg/m^3	µg/m^3
1	BASE OILS	0.00	0.00	-	-	-	-	-
2	LAB	0.02	0.05	-	-	-	-	-
3	STYRENE MONOMER	0.08	0.23	Below	400	425000	1000	215000

Aegis Tanker Gantry Loading Losses

SR. NO.	Product	Vapour emission	Resultant Vapour concentration level in Complainant Resident area	Below/Above	AAQC, MoECC. Canada (Health)	US EPA OSHA PEL	US EPA OSHA RfC	Factories Act, 1948 (India)
		Kg/day	µg/m^3		µg/m^3	µg/m^3	µg/m^3	µg/m^3
1	METHANOL	0.60	0.04	Below	4,000	260,000	10,000	260,000
2	ACETONE	0.91	0.06	Below	11,880	-	-	-
3	ETHYL ACETATE	0.07	0.00	Below	19,000 (Odour)	-	-	1,400,000
4	BUTYL ACETATE	0.01	0.00	Below	15,000	-	-	710,000
5	ISO PROPYL ALCOHOL	0.04	0.00	Below	7,300	-	-	-
6	MEK	0.01	0.00	Below	1,000	590,000	1,000	590,000
7	ORTHO XYLENE	0.00	0.00	Below	730	435,000	400	435,000
8	TOLUENE	0.24	0.02	Below	2,000 (Odour)	754,000	5,000	375,000
9	ETHANOL	0.24	0.02	Below	19,000 (Odour)	-	-	1,900,000
10	VAM	0.04	0.00	Below	-	-	200	-
11	MIX-XYLENE	0.02	0.00	Below	730	435,000	400	435,000
12	MOTOR SPIRIT	1.73	0.12	-	-	-	-	-
13	ACETIC ACID	0.20	0.01	Below	2,500 (Odour)	-	-	25,000
14	DIMETHYL FORMAMIDE	0.00	0.00	-	-	-	-	-
15	LAB	0.00	0.00	-	-	-	-	-
16	HSD	0.13	0.01	-	-	-	-	-
17	MEG	0.00	0.00	-	-	-	-	-
18	ISONONANOL	0.00	0.00	-	-	-	-	-
19	PROPYL HEPTANOL	0.00	0.00	-	-	-	-	-
20	STYRENE MONOMER	0.11	0.00	Below	400	425,000	1,000	215,000
21	BASE OIL	0.00	0.00	-	-	-	-	-
22	n-BUTANOL	0.00	0.00	-	-	-	-	-
23	ACETIC ANHYDRIEE	0.00	0.00	-	-	-	-	-
24	ALPHA OLEFIN C-14	0.00	0.00	-	-	-	-	-
25	CYCLOHEXANONE	0.00	0.00	-	-	-	-	-

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Sea Lord Tanker Gantry Loading Losses

SR. NO.	Product	Vapour emission	Resultant Vapour concentration level in Complainant Resident area	Below/Above	AAQC, MoECC. Canada (Health)	US EPA OSHA PEL	US EPA OSHA RfC	Factories Act, 1948 (India)
		Kg/day	µg/m³		µg/m³	µg/m³	µg/m³	µg/m³
1	CAUSTIC SODA LYE	0.00	0.00	-	-	-	-	-
2	BASE OILS	0.00	0.00	-	-	-	-	-
3	ETHANOL	0.25	0.84	Below	19,000 (Odour)	-	-	1,900,000
4	METHANOL	1.48	5.09	Below	4,000	260,000	10,000	260,000
5	LAB	0.00	0.00	-	-	-	-	-
6	n-PARAFFIN	0.00	0.01	-	-	-	-	-
7	STYRENE MONOMER	0.00	0.00	Below	400	425,000	1,000	215,000

Aegis ETP VOC Emissions

SR.NO.	Item	Vapour emission	Resultant Vapour concentration level in Complainant Resident area	Below/Above	Canada MoE& CC. AAQC (Health)	US EPA OSHA PEL	US EPA OSHA RfC	Factories Act, 1948 (India)
		Kg/day	µg/m³		µg/m³	µg/m³	µg/m³	µg/m³
1	Collection Tank	0.03	0.00	-	-	-	-	-
2	Primary Settling Tank	0.03	0.00	-	-	-	-	-
3	Equalisation Tank 1	0.03	0.00	-	-	-	-	-
4	Equalisation Tank 2	0.03	0.00	-	-	-	-	-
5	Buffer Tank	0.03	0.00	-	-	-	-	-
6	Sludge Tank	0.03	0.00	-	-	-	-	-

Sea Lord ETP VOC Emissions

SR. NO	Item	Vapour emission	Resultant Vapour concentration level in Complainant Resident area	Below/ Above	AAQC, MoECC. Canada (Health)	US EPA OSHA PEL	US EPA OSHA RfC	Factories Act, 1948 (India)
		Kg/day	µg/m³		µg/m³	µg/m³	µg/m³	µg/m³
1	ETP Feed Tank	0.02	0.09	-	-	-	-	-

INSTITUTE OF CHEMICAL TECHNOLOGY
रसायन तंत्रज्ञान संस्था
Campuses - Matunga, Mumbai • IOC Bhubaneswar, Odisha • Marathwada, Jalna
Category I Deemed to be University (MHRD/UGC)
A++ Grade by NAAC (CGPA 3.77)
Elite Status and Centre of Excellence–Govt. of Maharashtra

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From above comparison, it is observed that all the above emissions inventory with standard dispersion modelling to assess the effect on complainant residents are well below both Indian and international permissible limits for both health and ambient air quality and are therefore unlikely to have any health effects on surrounding population.

Conclusion:

From the all above data and after modelling the dispersion of the emitted products, we observe that the vapour concentration in the complainant resident areas would be well below all Indian and international permitted levels with respect to chronic health effects.

Other products such as Benzene or Ethyl Benzene are not stored or handled by Aegis or Sea Lord and therefore no emissions or impact can be attributable to them.

We conclude that there is unlikely to be any harmful effect on human health of surrounding population in the area account of air emissions of Volatile products from the Aegis or Sealord Terminals.

AVPatwardhan

Date: 23rd March 2020

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AEGIS LOGISTICS LIMITED VOC ESTIMATION DATA

Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Diameter	Tank Height	Tank Height	Liquid Height	Tank Capacity	Turnover per year	Throughput	Product withdrawal shell clingage factor	density of product	density of product	Zero Wind speed rim seal loss factor	Wind speed dependent rim seal loss factor	Average ambient wind speed	Seal wind speed exponent	True Vapor Pressure	True Vapor Pressure	Atmospheric pressure	Vapor Pressure function	Molecular weight of vapor	Vapor space volume	stock vapor density	Vapor space expansion factor	vented vapor saturatin factor	Total Deck fitting loss factor	Turn over factor	Working loss product factor	Liquid surface temp	Product Factor	Standing loss	Working loss	Total loss	Total loss
			(m)	(ft)	(m)	(ft)	(ft)		/yr	bbl/yr	bbl/1000ft2	Kg/m3	lb/gal	(lbmole/ft-yr)	(lbmole/(mph)^n-ft-yr)	mph	-	mmHg	psia	psia	-	lb/lbmole		lb/ft3			lb-mole/yr			celsius	-	*Note 1	*Note2	LT	LT
				D		H	H'	KL	N	Q	C	Rho	WL	KRa	KRb	v	n	PVA	PVA	PA	P*	Mv	VV	Wv	KE	KS	FF	KN	kp		Kc	Ls	Lw	lb/yr	kg/day
MEK	VFR TANK			41.01		32.97	29.4	1250	2.13	16778.9893	NA	784	6.54	NA	NA	4.8	NA	89.92	1.738	14.7	0.0314	72.1	5288.88	0.02176085	0.167	0.66	NA	1	1	25	NA	4630.127	2102.758	6732.88	8.36
VAM	VFR TANK								3.56	27995.7757	NA	917.1	7.65	NA	NA	4.8	NA	114.611	2.215	14.7	0.0408	86.09	5288.88	0.03311794	0.081	0.82	NA	1	1	25	NA	4246.379	5339.534	9585.91	11.90
STYRENE MONOMER	VFR TANK			68.90		49.22	46.92	5000	15.73	494601.763	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	11239.46	0.00232584	0.016	0.98	NA	1	1	25	NA	149.611	6624.944	6774.55	8.41
STYRENE MONOMER	VFR TANK			68.9		49.22	47.41	5000	11.79	370824.867	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	9404.45	0.00232584	0.016	0.98	NA	1	1	25	NA	125.1847	4967.014	5092.20	6.32
ACETONE	VFR TANK			68.9		49.22	46.52	5000	4.92	154784.458	NA	778.25	6.49	NA	NA	4.8	NA	229.698	4.440	14.7	0.0897	58.08	12707.47	0.04477836	0.362	0.51	NA	1	1	25	NA	38344.13	39915.63	78259.76	97.13
MEG	VFR TANK								0.26	8275.62728	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	12707.47	1.25E-05	0.041	1	NA	1	1	25	NA	2.377131	0.595752	2.97	0.00
STYRENE MONOMER	VFR TANK			68.9		49.22	47.08	5000	14.84	466834.827	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	10627.79	0.00232584	0.016	0.98	NA	1	1	25	NA	141.4689	6253.02	6394.49	7.94
HSD BS 4	VFR TANK			85.31		65.62	61.52	10000	11.04	694370.325	NA	818.75	6.83	NA	NA	4.8	NA	10	0.193	14.7	0.0033	90	28519.24	0.00302083	0.07	0.93	NA	1	1	25	NA	2047.098	12079.96	14127.06	17.53
MS BSIV	VFR TANK								0.80	50193.4039	NA	707.66	5.90	NA	NA	4.8	NA	245.9	4.753	14.7	0.0973	68	28519.24	0.05612441	0.209	0.44	NA	1	1	25	NA	53725.63	16223.55	69949.19	86.81
ETHYL ALCOHOL DEN.	VFR TANK			85.31		65.62	60.66	10000	3.18	200255.954	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	33432.36	0.00913256	0.137	0.68	NA	1	1	25	NA	10382.02	10532.35	20914.37	25.96
HSD BS 4	VFR TANK								1.00	62699.4015	NA	818.75	6.83	NA	NA	4.8	NA	10	0.193	14.7	0.0033	90	7092.13	0.00302083	0.07	0.92	NA	1	1	25	NA	503.596	1090.781	1594.38	1.98
METHANOL	VFR TANK								2.69	169432.331	NA	780.7	6.51	NA	NA	4.8	NA	127.039	2.456	14.7	0.0457	32.04	7092.13	0.01366199	0.226	0.54	NA	1	1	25	NA	4316.042	13330.85	17646.89	21.90
BASE OIL	VFR TANK			46.59		65.62	61.95	3000	6.62	124972.066	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	7092.13	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
ETHYL ACETATE	VFR TANK			19.03		82.03	74.38	640	0.94	3803.46864	NA	887.5	7.40	NA	NA	4.8	NA	94.3087	1.823	14.7	0.0331	88.1	2230.69	0.02788766	0.158	0.51	NA	1	1	25	NA	1829.664	610.8567	2440.52	3.03
ISONONANOL	VFR TANK								0.70	2809.77623	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2230.69	0.00022273	0.043	0.99	NA	1	1	25	NA	7.720009	3.604137	11.32	0.01
BASE OIL	VFR TANK			22.64		82.03	79.07	900	7.62	43160.7694	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK			22.64		82.03	79.07	900	5.90	33417.9731	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK								0.92	5229.8124	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK			22.97		82.03	80.38	930	2.87	16778.7062	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	778.75	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
ISONONANOL	VFR TANK			19.69		82.03	80.38	685	3.86	16634.8586	NA	826.7	6.895	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	561.74	0.00022273	0.043	1	NA	1	1	25	NA	1.963716	21.33775	23.30	0.03
PROPYLHEPTANOL	VFR TANK								3.27	14082.589	NA	811	6.76	NA	NA	4.8	NA	0.04	0.001	14.7	0.0000	158.3	561.74	2.1253E-05	0.043	1	NA	1	1	25	NA	0.187379	1.723675	1.91	0.00
ACETIC ACID	VFR TANK			36.09		82.025	79.15	2300	12.10	175029.446	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	3321.6	0.00309994	0.072	0.94	NA	1	1	25	NA	254.3632	3124.729	3379.09	4.19
ISONONANOL	VFR TANK								1.06	15310.6301	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	3321.6	0.00022273	0.043	1	NA	1	1	25	NA	11.61156	19.63915	31.25	0.04
MEG	VFR TANK								0.93	13432.9787	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	3321.6	1.25E-05	0.041	1	NA	1	1	25	NA	0.621357	0.967024	1.59	0.00
ACETIC ACID	VFR TANK			26.25		82.025	78.42	1200	5.11	38537.0788	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2100.86	0.00309994	0.072	0.92	NA	1	1	25	NA	157.4577	687.9866	845.44	1.05
ACETIC ANHYDRIDE	VFR TANK								0.80	5841.53853	NA	1050	8.76	NA	NA	4.8	NA	5.253	0.102	14.7	0.0017	102.09	2100.86	0.00180001	0.06	0.98	NA	1	1	25	NA	81.16004	60.55496	141.71	0.18
ALPHAOLEFINC-14	VFR TANK								1.33	10023.9666	NA	910	7.59	NA	NA	4.8	NA	0.16	0.003	14.7	0.0001	196	2100.86	0.00010526	0.041	1	NA	1	1	25	NA	3.309285	6.076416	9.39	0.01
ETHYL ALCOHOL DEN.	VFR TANK								0.73	5508.25821	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2100.86	0.00913256	0.137	0.76	NA	1	1	25	NA	729.1495	289.7038	1018.85	1.26
MEG	VFR TANK								2.24	16872.5656	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	2100.86	1.25E-05	0.041	1	NA	1	1	25	NA	0.392999	1.214636	1.61	0.00
ACETIC ACID	VFR TANK			27.89		82.025	75.23	1375	5.08	43923.6105	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	4326.21	0.00309994	0.072	0.87	NA	1	1	25	NA	306.6238	784.1502	1090.77	1.35
ETHYL ACETATE	VFR TANK								2.07	17890.4945	NA	887.5	7.40	NA	NA	4.8	NA	94.3087	1.823	14.7	0.0331	88.1	4326.21	0.02788766	0.158	0.54	NA	1	1	25	NA	3757.191	2873.306	6630.50	8.23
ETHYL ALCOHOL DEN.	VFR TANK								0.93	8010.22498	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4326.21	0.00913256	0.137	0.64	NA	1	1	25	NA	1264.426	421.2934	1685.72	2.09
MEG	VFR TANK								0.80	6925.17708	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4326.21	1.25E-05	0.041	1	NA	1	1	25	NA	0.809285	0.498535	1.31	0.00
DIMETHYL FORMAMIDE	VFR TANK			32.81		82.025	79.3	1900	2.34	27941.376	NA	937.9	7.82	NA	NA	4.8	NA	3.995	0.077	14.7	0.0013	73.05	2591.4	0.00097954	0.044	0.98	NA	1	1	25	NA	39.95098	157.6219	197.57	0.25
ACETIC ACID	VFR TANK			32.81		82.025	79.4	1900	9.85	117722.142	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2508.18	0.00309994	0.072	0.94	NA	1	1	25	NA	192.0727	2101.645	2293.72	2.85
ISONONANOL	VFR TANK								0.36	4278.0683	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2508.18	0.00022273	0.043	1	NA	1	1	25	NA	8.768031	5.487535	14.26	0.02
MEG	VFR TANK								2.58	30795.587	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	2508.18	1.25E-05	0.041	1	NA	1	1	25	NA	0.469194	2.216937	2.69	0.00
BASE OIL	VFR TANK			49.22		82.025	80.06	4300	1.08	29217.6741	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK								0.55	14755.9485	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK								2.22	59993.6949	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK								0.68	18330.3514	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK								1.07	28857.9567	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK								0.56	15068.3937	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	1.31	18911.74	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK			32.81		82.025	80.06	1900	3.74	44701.1906	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1953.37	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
ALPHAOLEFINC-14	VFR TANK			49.22		82.025	80.06	4300	0.46	12490.934	NA	910	7.59	NA	NA	4.8	NA	0.16	0.003	14.7	0.0001	196	4720.17	0.00010526	0.041	1	NA	1	1	25	NA	7.435236	7.571864	15.01	0.02
ETHYL ALCOHOL DEN.	VFR TANK								2.53	68559.8964	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4720.17	0.00913256	0.137	0.84	NA	1	1	25	NA	1810.685	3605.87	5416.55	6.72
LAB	VFR TANK								0.28	7592.80797	NA	847.35	7.07	NA	NA	4.8	NA	0.01	0.000	14.7	0.0000	326.49	4720.17	1.0959E-05	0.041	1	NA	1	1	25	NA	0.774085	0.479186	1.25	0.00
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	5.41	78333.6946	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
ISONONANOL	VFR TANK			36.09		82.025	80.06	2300	8.59	124242.556	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2398.54	0.00108079	0.043	1	NA	1	1	25	NA	40.68633	159.3676	200.05	0.25
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	1.64	23777.504	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
BASE OIL	VFR TANK			33.63		82.025	80.06	2000	2.78	34956.9327	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2059.85	0	0.04	1	NA	1	1	25	NA	0	0	0.00	0.00
MEG	VFR TANK			49.22		82.025	80.06	4300	10.28	278142.765	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	20.02316	20.91	0.03
ETHYL ALCOHOL DEN.	VFR TANK			49.22		82.025	80.06	4300	1.63	44039.4846	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4720.17	0.00913256	0.137	0.84	NA	1	1	25	NA	1810.685	2316.233	4126.92	5.12
MEG	VFR TANK								6.30	170272.396	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	12.2577	13.14	0.02
ACETIC ACID	VFR TANK			36.09		82.025	80.06	2300	14.00	202488.469	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2398.54	0.00309994	0.072	0.95	NA	1	1	25	NA	185.6306	3614.943	3800.57	4.72
ETHYL ALCOHOL DEN.	VFR TANK								1.01	14609.1731	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2398.54	0.00913256	0.137	0.84	NA	1	1	25	NA	920.0938	768.3615	1688.46	2.10
MEG	VFR TANK			49.22		82.025	80.06	4300	9.95	269225.807	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	19.38124	20.26	0.03
ACETIC ACID	VFR TANK			39.37		82.025	80.38	2800	15.31	269710.398	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2496.62	0.00309994	0.072	0.96	NA	1	1	25	NA	195.2553	4815.029	5010.28	6.22
ETHYL ALCOHOL DEN.	VFR TANK								0.95	16809.8078	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2496.62	0.00913256	0.137	0.86	NA	1	1	25	NA	980.5207	884.1027	1864.62	2.31
ACETIC ACID	VFR TANK			41.01		82.025	80.22	3000	16.27	306944.808	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2948.3	0.00309994	0.072	0.96	NA	1	1	25	NA	230.5802	5479.759	5710.34	7.09
ETHYL ALCOHOL DEN.	VFR TANK								0.79	14864.3478	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2948.3	0.00913256	0.137	0.86	NA	1	1	25	NA	1157.913	781.7823	1939.70	2.41
ACETIC ACID	VFR TANK			49.22		82.025	80.06	4300	16.90	457033.683	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	4720.17	0.00309994	0.072	0.95	NA	1	1	25	NA	365.3089	8159.234	8524.54	10.58
MEG	VFR TANK			49.22		82.025	80.06	4300	8.76	237002.322	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	17.06151	17.94	0.02
ACETIC ACID	VFR TANK			36.09		82.025	80.06	2300	15.30	221351.66	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2398.54	0.00309994	0.072	0.95	NA	1	1	25	NA	185.6306	3951.7	4137.33	5.13
																																		299405	372

Calculation done as per AP42

Note 1: Standing loss=365* Vv*Wv*Ke*Ks

Note2: Working loss=0.001*Mv*Q*Pv*Kn*Kp

Above method is verified by ICT,Mumbai,Chemical Engg. Dept. & BITS Pilani,Chemical Engg. dept.(Environment)

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SEA LORD CONTAINERS LTD VOC ESTIMATION DATA

Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Height	Liquid Height	Tank Capacity	Turnover per year	Throughput	Product withdrawal shell clingage factor	density of product	density of product	Zero Wind speed rim seal loss factor	Wind speed dependent rim seal loss factor	Average ambient wind speed	Seal wind speed exponent	True Vapor Pressure
			(ft)	(ft)	(ft)		/yr	bbl/yr	bbl/1000ft2	Kg/m3	lb/gal	(lbmole/ft-yr)	(lbmole/(mph)^n-ft-yr)	mph	-	mmHg
			D	H	H'	KL	N	Q	C	Rho	WL	KRa	KRb	v	n	
LAB	VFR TANK		59.06	65.62	64.37	5000	7.55	237310.89	NA	847.35	7.07	NA	NA	4.8	NA	0.01
BASE OIL EHC	VFR TANK		59.06	65.62	64.37	5000	0.96	30146.55	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0
BASE OIL ULTRA2							0.73	22925.55	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0
BASE OIL SN 500							0.45	14011.94	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0
STYRENE MONOMER							0.82	25693.62	NA	896.6	7.48	NA	NA	4.8	NA	6.59

Service	True Vapor Pressure	Atmospheric pressure	Vapor Pressure function	Molecular weight of vapor	Total Deck fitting loss factor	Turn over factor	Working loss product factor	Product Factor	Vented Vapour Space saturation factor	Vapour space Expansion factor	Liquid surface temp.	Vapor space volume	stock vapor density	Standing loss	Working loss	Total loss	Total loss
	psia	psia	-	lb/lbmole	lb-mole/yr			-			Degree Celcius	ft3	lb/ft3	*Note 1	*Note 2	LT	LT
	PVA	PA	P*	Mv	FF	KN	KP	Kc	KS	KE		Vv	Wv	Ls	Lw	Lb/yrs	KG/day
LAB	0.00019	14.7	0.0000	326.49	NA	1	1	NA	1.000	0.040	25	5099.840	1.096E-05	0.815935	14.97681	15.7927476	0.0196
BASE OIL EHC	0.00	14.7	0.0000	700	NA	1	1	NA	1.000	0.040	25	5099.840	0	0	0	0	0
BASE OIL ULTRA2	0.00	14.7	0.0000	700	NA	1	1	NA	1.000	0.040	25	5099.840	0	0	0	0	0
BASE OIL SN 500	0.00	14.7	0.0000	700	NA	1	1	NA	1.000	0.040	25	5099.840	0	0	0	0	0
STYRENE MONOMER	0.127	14.7	0.0022	105.15	NA	1	1	NA	0.986	0.016	25	5099.840	0.0023258	67.36738	0.01091	67.37829064	0.083623
																83	**0.103**

Calculation done as per AP42

Note 1: Standing loss=365* Vv*Wv*Ke*Ks

Note2: Working loss=0.001*Mv*Q*Pv*Kn*Kp

Above method is verified by ICT,Mumbai,Chemical Engg. Dept. & BITS Pilani,Chemical Engg. dept.(Environment)

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AEGIS - TANKER GANTRY VOC LOADING LOSS

Tank No	Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Height	Liquid Height	Tank Capacity	Throughput	Throughput	True Vapor Pressure	Molecular weight of vapor	Saturation Factor	Temperature	*Emission Reduction Efficiency of vapour Control System	*Loading loss	*Loading loss	*Loading Loss
				(ft)	(ft)	(ft)		bbl/yr	gallon /yr	psia	lb/lbmole	-	R	%	LB/1000 gallon	LB/yrs	Kg/day
				D	H	H'	KL	Q	Q	PVA	Mv	S					
T113	MIX-XYLENE	Internal Floating Roof tank with Cone Roof with double wiper seals (IFR+CONE ROOF TANK)*		41.01	28.54	23.32	1000	19012.4627	798523.433	0.226	106.17	0.5	536.67	99	0.002787965	2.2262557	0.002763
	ORTHO-XYLENE							6457.7713	271226.395	0.127	106.168	0.5	536.67	99	0.001570772	0.4260347	0.00052875
	VAM							3597.35273	151088.815	2.215	86.09	0.5	536.67	99	0.022140712	3.345214	0.00415173
T114	CYCLOHEXANONE	IFR+CONE ROOF TANK*		41.01	34.45	29.86		6546.78076	274964.792	1.837	98.15	0.5	536.67	99	0.020930528	5.7551583	0.0071427
	NBUTANOL						1250	8479.08955	356121.761	0.119	74.12	0.5	536.67	99	0.001026013	0.3653857	0.00045348
	ORTHO-XYLENE							25203.1097	1058530.61	0.127	106.168	0.5	536.67	99	0.001570772	1.6627099	0.00206358
T115	MEK	VFR TANK		41.01	#	29.4	1250	16778.9893	704717.552	1.738	72.1	0.5	536.67	99	0.014548029	10.252251	0.01272403
	VAM							27995.7757	1175822.58	2.215	86.09	0.5	536.67	99	0.022140712	26.03355	0.03231013
T116	ACETONE	IFR+CONE ROOF TANK*		41.73	#	29.4	1350	7894.07279	331551.057	4.440	58.08	0.5	536.67	99	0.029936182	9.9253726	0.01231834
	TOLUENE							7503.7123	315155.917	0.548	92.13	0.5	536.67	99	0.005862524	1.8476092	0.00229306
	VAM							6830.08772	286863.684	2.215	86.09	0.5	536.67	99	0.022140712	6.3513663	0.00788265
T117	BUTYL ACETATE	IFR+CONE ROOF TANK*		41.73	#	30.25	1340	14403.3348	604940.061	0.243	116.16	0.5	536.67	99	0.003276752	1.9822387	0.00246015
	MIX-XYLENE							54511.6245	2289488.23	0.226	106.17	0.5	536.67	99	0.002787965	6.3830139	0.00792193
	ORTHO-XYLENE							9809.1973	411986.287	0.127	106.168	0.5	536.67	99	0.001570772	0.6471364	0.00080316
	TOLUENE							7657.09321	321597.915	0.548	92.13	0.5	536.67	99	0.005862524	1.8853756	0.00233993
T118	BUTYL ACETATE	IFR+CONE ROOF TANK*		41.73	#	30.38	1330	69620.5648	2924063.72	0.243	116.16	0.5	536.67	99	0.003276752	9.5814324	0.01189148
T119	ACETONE	IFR+CONE ROOF TANK*		68.9	#	43.27	5000	223703.572	9395550.04	4.440	58.08	0.5	536.67	99	0.029936182	281.26689	0.34907918
	BASE OIL							28501.7935	1197075.33	0	700	0.5	536.67	0	0	0	0
	METHANOL							28564.6751	1199716.36	2.456	32.04	0.5	536.67	99	0.009133604	10.957734	0.0135996
T120	STYRENE MONOMER	VFR TANK		68.90	#	46.92	5000	494601.763	20773274	0.127	105.15	0.5	536.67	99	0.001554917	32.300722	0.04008829
T121	ACETONE	IFR+CONE ROOF TANK*		68.9	#	43.96	5000	79482.6246	3338270.23	4.440	58.08	0.5	536.67	99	0.029936182	99.935064	0.124029
	ETHYL ALCOHOL DEN.							31506.3954	1323268.61	1.142	46.04	0.5	536.67	99	0.006105492	8.0792062	0.01002707
	METHANOL							83083.8833	3489523.1	2.456	32.04	0.5	536.67	99	0.009133604	31.87192	0.03955611
	MS BSIV							19112.6535	802731.445	4.753	68	0.5	536.67	99	0.037521485	30.119676	0.03738141
T122	ETHYL ALCOHOL DEN.	IFR+CONE ROOF TANK*		68.9	49.22	45.93	5000	16810.1372	706025.76	1.142	46.04	0.5	536.67	99	0.006105492	4.3106348	0.00534991
	MS BSIV							246723.104	10362370.4	4.753	68	0.5	536.67	99	0.037521485	388.81153	0.48255239
T123	STYRENE MONOMER	VFR TANK		68.9	#	47.41	5000	370824.867	15574644.4	0.127	105.15	0.5	536.67	99	0.001554917	24.217283	0.03005597
T124	ACETONE	VFR TANK		68.9	#	46.52	5000	154784.458	6500947.22	4.440	58.08	0.5	536.67	99	0.029936182	194.61354	0.24153406
	MEG							8275.62728	347576.346	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0029047	3.605E-06
T125	ISO PROPYL ALCOHOL	IFR+CONE ROOF TANK*		68.9	#	45.24	5000	55551.3726	2333157.65	0.803	60.09	0.5	536.67	99	0.005597937	13.060869	0.01620979
	METHANOL							132294.781	5556380.78	2.456	32.04	0.5	536.67	99	0.009133604	50.749779	0.06298534
	MIX-XYLENE							18319.9319	769437.139	0.226	106.17	0.5	536.67	99	0.002787965	2.1451641	0.00266235
T126	STYRENE MONOMER	VFR TANK		68.9	#	47.08	5000	466834.827	19607062.8	0.127	105.15	0.5	536.67	99	0.001554917	30.48736	0.03783774
T127	HSD BS 4	IFR+CONE ROOF TANK*		85.31	#	59.38	10000	516130.218	21677469.2	0.193	90	0.5	536.67	99	0.002019552	43.778781	0.05433367
T128	MS BSIV	IFR+CONE ROOF TANK*		85.31	#	59.19	10000	568707.446	23885712.7	4.753	68	0.5	536.67	99	0.037521485	896.22742	1.11230417
T129	HSD BS 4	VFR TANK		85.31	#	61.52	10000	694370.325	29163553.7	0.193	90	0.5	536.67	99	0.002019552	58.89732	0.07309722
	MS BSIV							50193.4039	2108122.97	4.753	68	0.5	536.67	99	0.037521485	79.099905	0.09817057
T130	ACETONE	Internal Floating Roof tank with Dome Roof with double wiper seals (IFR+DOME ROOF TANK)		85.31	#	60.6	10000	38113.82	1600780.44	4.440	58.08	0.5	536.67	99	0.029936182	47.921254	0.05947487
	ETHYL ALCOHOL DEN.							54739.3502	2299052.71	1.142	46.04	0.5	536.67	99	0.006105492	14.036848	0.01742107
	METHANOL							695483.98	29210327.2	2.456	32.04	0.5	536.67	99	0.009133604	266.79555	0.33111886
T131	ETHYL ALCOHOL DEN.	IFR+DOME ROOF TANK		85.31	#	60.63	10000	118030.764	4957292.09	1.142	46.04	0.5	536.67	99	0.006105492	30.266708	0.03756389
	TOLUENE							551801.458	23175661.2	0.548	92.13	0.5	536.67	99	0.005862524	135.86788	0.16862506
T132	ETHYL ALCOHOL DEN.	IFR+DOME ROOF TANK		85.31	#	60.65	10000	154078.419	6471293.6	1.142	46.04	0.5	536.67	99	0.006105492	39.510433	0.04903624
	METHANOL							126792.072	5325267.01	2.456	32.04	0.5	536.67	99	0.009133604	48.638878	0.06036551
	MIX-XYLENE							31453.115	1321030.83	0.226	106.17	0.5	536.67	99	0.002785422	3.6796282	0.00456677
	TOLUENE							222361.069	9339164.9	0.548	92.13	0.5	536.67	99	0.005862524	54.751081	0.06795134
T133	ETHYL ALCOHOL DEN.	VFR TANK		85.31	#	60.66	10000	200255.954	8410750.06	1.142	46.04	0.5	536.67	99	0.006105492	51.351769	0.06373247
	HSD BS 4							62699.4015	2633374.86	0.193	90	0.5	536.67	99	0.002019552	5.3182381	0.00660044
	METHANOL							169432.331	7116157.92	2.456	32.04	0.5	536.67	99	0.009133604	64.996165	0.08066647
T134	BASE OIL	VFR TANK		46.59	#	61.95	3000	124972.066	5248826.79	0.000	700	0.5	536.67	0	0	0	0
T135	ETHYL ACETATE	IFR+DOME ROOF TANK		46.59	#	62.08	3000	55504.9514	2331207.96	1.823	88.1	0.5	536.67	99	0.01864405	43.463151	0.05394195
	ORTHO-XYLENE							20541.1347	862727.656	0.126	106.168	0.5	536.67	99	0.001552905	1.3397342	0.00166274
T136	METHANOL	IFR+DOME ROOF TANK		46.59	#	61.96	3000	16034.6475	673455.194	2.456	32.04	0.5	536.67	99	0.009133604	6.1510727	0.00763407
	ORTHO-XYLENE							17431.4723	732121.837	0.126	106.168	0.5	536.67	99	0.001552905	1.1369157	0.00141102
T137	ACETONE	IFR+DOME ROOF TANK		46.59	#	62.08	3000	81884.516	3439149.67	4.440	58.08	0.5	536.67	99	0.029936182	102.95501	0.12777704
	ETHYL ALCOHOL DEN.							17080.5423	717382.778	1.142	46.04	0.5	536.67	99	0.006105492	4.379975	0.00543597
	ISO PROPYL ALCOHOL							89999.4306	3779976.08	0.803	60.09	0.5	536.67	99	0.005597937	21.160066	0.02626167
	METHANOL							13229.4466	555636.759	2.456	32.04	0.5	536.67	99	0.009133604	5.0749659	0.00629852
T138	ETHYL ACETATE	VFR TANK		19.03	#	74.38	640	3803.46864	159745.683	1.823	88.1	0.5	536.67	99	0.01864405	2.9783064	0.00369636
	ISONONANOL							2809.77623	118010.602	0.009	144.258	0.5	536.67	99	0.000148905	0.0175724	2.1809E-05
T139	BASE OIL	VFR TANK		22.64	#	79.07	900	43160.7694	1812752.32	0.000	700	0.5	536.67	0	0	0	0
T140	BASE OIL	VFR TANK		22.64	#	79.07	900	33417.9731	1403554.87	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							5229.8124	219652.121	0.000	700	0.5	536.67	0	0	0	0
T141	BASE OIL	VFR TANK		22.97	#	80.38	930	16778.7062	704705.661	0.000	700	0.5	536.67	0	0	0	0
T142	ISONONANOL	VFR TANK		19.69	#	80.38	685	16634.8586	698664.06	0.009	144.258	0.5	536.67	99	0.000148905	0.1040348	0.00012912
	PROPYLHEPTANOL							14082.589	591468.738	0.001	158.3	0.5	536.67	99	1.42087E-05	0.008404	1.043E-05
T143	ACETIC ACID	VFR TANK		36.09	82.03	79.15	2300	175029.446	7351236.73	0.297	60.05	0.5	536.67	99	0.00207244	15.234996	0.01890809
	ISONONANOL							15310.6301	643046.464	0.009	144.258	0.5	536.67	99	0.000148905	0.0957531	0.00011884
	MEG							13432.9787	564185.106	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0047148	5.8516E-06
T144	ACETIC ACID	VFR TANK		26.25	82.03	78.42	1200	38537.0788	1618557.31	0.297	60.05	0.5	536.67	99	0.00207244	3.3543626	0.00416309
	ACETIC ANHYDRIDE							5841.53853	245344.618	0.102	102.09	0.5	536.67	99	0.001203381	0.2952431	0.00036642
	ALPHAOLEFINC-14							10023.9666	421006.599	0.003	196	0.5	536.67	99	7.03702E-05	0.0296263	3.6769E-05
	ETHYL ALCOHOL DEN.							5508.25821	231346.845	1.142	46.04	0.5	536.67	99	0.006105492	1.4124864	0.00175303
	MEG							16872.5656	708647.757	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0059221	7.3499E-06
T145	ACETIC ACID	VFR TANK		27.89	82.03	75.23	1375	43923.6105	1844791.64	0.297	60.05	0.5	536.67	99	0.00207244	3.8232197	0.00474498
	ETHYL ACETATE							17890.4945	751400.769	1.823	88.1	0.5	536.67	99	0.01864405	14.009153	0.0173867
	ETHYL ALCOHOL DEN.							8010.22498	336429.449	1.142	46.04	0.5	536.67	99	0.006105492	2.0540674	0.00254929
	MEG							6925.17708	290857.437	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0024307	3.0167E-06
T146	DIMETHYL FORMAMIDE	VFR TANK		32.81	82.03	79.3	1900	27941.376	1173537.79	0.077	73.05	0.5	536.67	99	0.000654862	0.7685049	0.00095379
T147	ACETIC ACID	VFR TANK		32.81	82.03	79.4	1900	117722.142	4944329.95	0.297	60.05	0.5	536.67	99	0.00207244	10.246826	0.01271729
	ISONONANOL							4278.0683	179678.869	0.009	144.258	0.5	536.67	99	0.000148905	0.0267551	3.3206E-05
	MEG							30795.587	1293414.65	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0108089	1.3415E-05
T150	BASE OIL	VFR TANK		49.22	82.03	80.06	4300	29217.6741	1227142.31	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							14755.9485	619749.836	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							59993.6949	2519735.18	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							18330.3514	769874.759	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							28857.9567	1212034.18	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							15068.3937	632872.536	0.000	700	0.5	536.67	0	0	0	0
T151	BASE OIL	VFR TANK		36.09	82.03	80.06	2300	18911.74	794293.081	0.000	700	0.5	536.67	0	0	0	0
T152	BASE OIL	VFR TANK		32.81	82.03	80.06	1900	44701.1906	1877450.01	0.000	700	0.5	536.67	0	0	0	0
T153	ALPHAOLEFINC-14	VFR TANK		49.22	82.03	80.06	4300	12490.934	524619.227	0.003	196	0.5	536.67	99	7.03702E-05	0.0369175	4.5818E-05
	ETHYL ALCOHOL DEN.							68559.8964	2879515.65	1.142	46.04	0.5	536.67	99	0.006105492	17.58086	0.02181953
	LAB							7592.80797	318897.935	0.000	326.49	0.5	536.67	99	7.32626E-06	0.0023363	2.8996E-06
T154	BASE OIL	VFR TANK		36.09	82.03	80.06	2300	78333.6946	3290015.17	0.000	700	0.5	536.67	0	0	0	0
T155	ISONONANOL	VFR TANK		36.09	82.03	80.06	2300	124242.556	5218187.33	0.009	144.258	0.5	536.67	99	0.000148905	0.777016	0.00096435
T156	BASE OIL	VFR TANK		36.09	82.03	80.06	2300	23777.504	998655.168	0.000	700	0.5	536.67	0	0	0	0
T157	BASE OIL	VFR TANK		33.63	82.03	80.06	2000	34956.9327	1468191.17	0.000	700	0.5	536.67	0	0	0	0
T158	MEG	VFR TANK		49.22	82.03	80.06	4300	278142.765	11681996.1	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0976254	0.00012116
T159	ETHYL ALCOHOL DEN.	VFR TANK		49.22	82.03	80.06	4300	44039.4846	1849658.36	1.142	46.04	0.5	536.67	99	0.006105492	11.293075	0.01401579
	MEG							170272.396	7151440.62	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0597639	7.4173E-05
T160	ACETIC ACID	VFR TANK		36.09	82.03	80.06	2300	202488.469	8504515.7	0.297	60.05	0.5	536.67	99	0.00207244	17.625097	0.02187444
	ETHYL ALCOHOL DEN.							14609.1731	613585.269	1.142	46.04	0.5	536.67	99	0.006105492	3.7462401	0.00464944
T161	MEG	VFR TANK		49.22	82.03	80.06	4300	269225.807	11307483.9	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0944956	0.00011728
T162	ACETIC ACID	VFR TANK		39.37	82.03	80.38	2800	269710.398	11327836.7	0.297	60.05	0.5	536.67	99	0.00207244	23.47626	0.02913629
	ETHYL ALCOHOL DEN.							16809.8078	706011.928	1.142	46.04	0.5	536.67	99	0.006105492	4.3105543	0.00534981
T163	ACETIC ACID	VFR TANK		41.01	82.03	80.22	3000	306944.808	12891681.9	0.297	60.05	0.5	536.67	99	0.00207244	26.717235	0.03315865
	ETHYL ALCOHOL DEN.							14864.3478	624302.606	1.142	46.04	0.5	536.67	99	0.006105492	3.8116747	0.00473065
T164	ACETIC ACID	VFR TANK		49.22	82.03	80.06	4300	457033.683	19195414.7	0.297	60.05	0.5	536.67	99	0.00207244	39.781342	0.04937246
T165	MEG	VFR TANK		49.22	82.03	80.06	4300	237002.322	9954097.52	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0831855	0.00010324
T166	ACETIC ACID	VFR TANK		36.09	82.03	80.06	2300	221351.66	9296769.74	0.297	60.05	0.5	536.67	99	0.00207244	19.266996	0.02391219
																3541.643	4.395519

Note : ***The loading loss calculations are based on AP-42 Chapter 5 with 99% emission reduction efficiency for vapour control sysytem having brine condenser,activated charcoal adsorber and water scrubbing system provided by the Company at tanker filling bay.**

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SEALORD - TANKER GANTRY VOC LOADING LOSS

Tank No	Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Height	Liquid Height	Tank Capacity	Throughput	Throughput	True Vapor Pressure	Molecular weight of vapor	Saturation Factor	Temperature	*Emission Reduction Efficiency of vapour Control System	*Loading loss	*Loading loss	*Loading Loss
				(ft)	(ft)	(ft)		bbl/yr	Gallon/yrs	psia	lb/lbmole	-	R		lb/1000 gallon	lb/Yrs	Kg/day
				D	H	H'	KL	Q		PVA	Mv	S					
T 201	ETHYL ALCOHOL DEN.	Internal Floating Roof tank with Dome Roof with double wiper seals (IFR+DOME ROOF TANK)		59.06	65.62	62.34	5000	130928.39	5498992.33	1.14	46.04	0.5	536.67	99	0.006103545	33.5633468	0.04165533
	METHANOL							75007.50	3150315.01	2.46	32.04	0.5	536.67	99	0.009134854	28.7776669	0.03571584
T 202	LAB	VFR TANK		59.06	65.62	64.37	5000	237310.89	9967057.36	0.00	326.49	0.5	536.67	99	7.32626E-06	0.07302128	9.0626E-05
T 203	METHANOL	IFR+DOME ROOF TANK		59.06	65.62	62.34	5000	322287.95	13536093.87	2.46	32.04	0.5	536.67	99	0.009134854	123.650238	0.1534618
T 204	ETHYL ALCOHOL DEN.	IFR+DOME ROOF TANK		59.06	65.62	62.34	5000	16303.58	684750.49	1.14	46.04	0.5	536.67	99	0.006103545	4.17940537	0.00518704
	METHANOL							276987.70	11633483.52	2.46	32.04	0.5	536.67	99	0.009149731	106.443249	0.13210628
T 205	BASE OIL EHC	VFR TANK		59.06	65.62	64.37	5000	30146.55	1266154.93	0.00	700	0.5	536.67	0	0	0	0
	BASE OIL ULTRA2							22925.55	962873.25	0.00	700	0.5	536.67	0	0	0	0
	BASE OIL SN 500							14011.94	588501.41	0.00	700	0.5	536.67	0	0	0	0
	STYRENE MONOMER							25693.62	1079132.00	0.13	105.15	0.5	536.67	99	0.001550221	1.67289352	0.00207622
T 206	ETHYL ALCOHOL DEN.	IFR+DOME ROOF TANK		85.30	65.62	62.50	10000	377359.99	15849119.64	1.14	46.04	0.5	536.67	99	0.006103545	96.735814	0.12005842
	METHANOL							39654.30	1665480.42	2.46	32.04	0.5	536.67	99	0.009134854	15.21392	0.01888193
T 207	ETHYL ALCOHOL DEN.	IFR+DOME ROOF TANK		85.30	65.62	62.99	10000	62169.08	2611101.15	1.14	46.04	0.5	536.67	99	0.006103545	15.9369732	0.01977931
	METHANOL							732078.10	30747280.17	2.46	32.04	0.5	536.67	99	0.009134854	280.871907	0.34858897
T 208	CAUSTIC	IFR+DOME ROOF TANK		85.30	65.62	62.52	10000	36390.30	1528392.53	0.00	39.99	0.5	536.67	0	0	0	0
	METHANOL							160221.09	6729285.96	2.46	32.04	0.5	536.67	99	0.009134854	61.471043	0.07629146
	N PARAFFIN							25603.76	1075357.78	0.15	185	0.5	536.67	99	0.003114013	3.34867841	0.00415603
T 209	ETHYL ALCOHOL DEN.	IFR+DOME ROOF TANK		85.30	65.62	62.99	10000	186551.95	7835181.98	1.14	46.04	0.5	536.67	99	0.006103545	47.8223854	0.05935217
	METHANOL							677760.17	28465927.22	2.46	32.04	0.5	536.67	99	0.009134854	260.032081	0.32272475
T 210	METHANOL	IFR+DOME ROOF TANK		85.30	65.62	62.99	10000	832793.64	34977333.03	2.46	32.04	0.5	536.67	99	0.009134854	319.512821	0.39654605
																1399.30544	1.736672

Note : *The loading loss calculations are based on AP-42 Chapter 5 with 99% emission reduction efficiency for vapour control sysytem having brine condenser,activated charcoal adsorber and water scrubbing system provided by the Company at tanker filling bay

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AEGIS LOGISTICES LTD - ETP VOC EMISSION ESTIMATION DATA

Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Height	Liquid Height	Tank Capacity	Throughput of ETP Water	density of product	True Vapor Pressure(1)	Molecular weight of vapor	Turn over factor	Working loss product factor	Vented Vapour Space saturation factor	Vapour space Expansion factor	Liquid surface temp.	Vapor space outage	Vapor space volume	stock vapor density	Standing loss	Working loss	Total loss	Total loss
			(ft)	(ft)	(ft)		bbl/yr	Kg/m3	psia	lb/lbmole					Degree Celcius	ft	ft3	lb/ft3			LT	LT
			D	H	H'	KL	Q	Rho	PVA	Mv	KN	KP	KS	KE		HVO	Vv	Wv	Ls	Lw	Lb/yrs	KG/day
Collection Tank	VFR TANK		18.4	13.1	6.6	100	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	7	1800.528	0.0001413	3.750689	20.55174	24.30242925	0.030162
Primary Settling Tank	VFR TANK		5.9	9.8	4.9	8.2	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	5	136.292	0.0001413	0.28391	20.55174	20.83565011	0.025859
Equalisation Tank 1	VFR TANK		8.5	9.8	4.9	15.6	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	5	285.906	0.0001413	0.595573	20.55174	21.14731312	0.026246
Equalisation Tank 2	VFR TANK		6.6	9.8	4.9	8.4	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	5	168.490	0.0001413	0.350982	20.55174	20.90272222	0.025942
Buffer Tank	VFR TANK		3.9	6.6	3.3	4.08	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	3	40.383	0.0001413	0.084121	20.55174	20.63586194	0.025611
Sludge Tank	VFR TANK		5.6	6.6	3.3	5.78	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	3	81.459	0.0001413	0.169687	20.55174	20.72142732	0.025717
																						0.159537

Note:

1. True vapor pressure - VAPOR PRESSURE OF METHANOL AT 25 DEG C * MOLE FRACTION OF METHANOL IN PRIMARY FEED TANK WATER 2.45*0.0104=0.0254

2. Basis for above Calculations:

ETP Water contains Water soluable products:

i) High volatile product viz Methanol, Ethanol , Acetone, Iso propyl alcohol & Acetic Acid.

ii) Low volatile products- MEG, Caustic Soda Lye

iii) For calculation purpose total high volatile products content in ETP waste Water is considered.Further, Properties of Methanol is considered for calculating total VOC emission from ETP.We expect actual emission were less as Methanol is high volatile product.

3. ETP operated at 11 KL/day capacity

4. All Above Tanks are covered.Collection tank vent is provided with Activated carbon adsorber.

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SEA LORD CONTAINER LTD - ETP VOC EMISSION ESTIMATION DATA

Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Height	Liquid Height	Tank Capacity	Throughput of ETP Water	density of product	True Vapor Pressure	Molecular weight of vapor	Turn over factor	Working loss product factor	Vented Vapour Space saturation factor	Vapour space Expansion factor	Liquid surface temp.	Vapor space outage	Vapor space volume	stock vapor density	Standing loss	Working loss	Total loss	Total loss
			(ft)	(ft)	(ft)		bbl/yr	Kg/m3	psia	lb/lbmole					Degree Celcius	ft	ft3	lb/ft3			LT	LT
			D	H	H'	KL	Q	Rho	PVA	Mv	KN	KP	KS	KE			Vv	Wv	Ls	Lw	Lb/yrs	KG/day
ETP Feed Tank	VFR TANK		9.84	8.20	4.10	17	9183.108	1000	0.05600	32.04	1	1	1.000	0.040	25	4	319.346	0.0003116	1.466652	16.4767	17.94335145	**0.022269**

Note :

1. True vapor pressure - VAPOR PRESSURE OF METHANOL AT 25 DEG C * MOLE FRACTION OF METHANOL IN ETP FEED TANK WATER
   2.45*0.023=0.056
2. Basis for above Calculations:

ETP Water Contains water Soluable products :

i)High volatile product viz Methanol, Ethanol

ii) For calculation purpose total high volatile products content in ETP Waste Water is considered. Further,Properties of Methanol is considered for calculating total VOC emission from ETP.We expect actual emission were less as Methanol is high volatile product.

3. ETP operated at 4 KL/day capacity
4. Trade Waste water is directly taken to ETP Feed tank & mixed with sewage water. This tank is covered and its vent is provided with Activated carbon adsorber.

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Appendix 2 – Summary of calculation of VOC concentration
(Aegis TANKER GANTRY)

$$\begin{cases} \bar{u}_1 = \bar{u}\left(\frac{z_1}{H}\right)^{\alpha} \quad \ldots\ (Eq.\ 1) \\ \alpha = 0.5 \textit{ for stable conditions};\ \alpha = 0.25 \textit{ for unstable conditions} \end{cases}$$

$$\left.\begin{cases} \sigma_y = \textit{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z = \textit{speading coefficient} = b \cdot x^{p} \end{cases}\right\} \ldots\ (Eq.\ 2)$$

$$\langle\rho\rangle(x,\ y,\ z,\ H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\textit{horizontal component}}\right]$$

$$\cdot \left\{\underbrace{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]}_{\textit{vertical component}}\right\} \ldots\ (Eq.\ 3)$$

$x = $ *logitudinal straight distance from the source tank* (m)

$y = $ *horizonal component from the source tank* $= 0$

$z = $ *vertical component from the source tank* $= 0$

$H = $ *tank height*

$Q = $ *source strength of VOC* $(\mu g/s)$

$\bar{u} = $ *corrected velocity in* x*-direction* (m/s)

$\rho = $ *VOC concentration* $\left(\mu g/m^3\right)$

Basis of calculations:

1. The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
2. Wind velocity data given by Sea Lord, and Aegis Terminal as per weather monitoring station provided at sites.
3. Strong solar radiation and unstable air conditions are assumed.

The Aegis tanker loading loss data is as follows:

Sr. No.	Product	Tanker Loading Gantry Vapour Control System Vent Pipe height (mtr)	*Loading Loss (kg/day)
1	Acetone	14	0.914
2	Butyl Acetate	14	0.014
3	Ethyl Acetate	14	0.0750
4	Ethyl Alcohol Den.	14	0.243
5	*iso*-Propyl Alcohol	14	0.0425
6	MEK	14	0.0127
7	Methanol	14	0.602

8	Mix-Xylene	14	0.0179
9	MS BS IV	14	1.73
10	n-Butanol	14	0.000453
11	*ortho*-Xylene	14	0.00647
12	Toluene	14	0.241
13	VAM	14	0.0443
14	Acetic Acid	14	0.198
15	Acetic Anhydride	14	0.000366
16	Alpha Olefin C-14	14	0.000083
17	**Base Oil**	**14**	**0**
18	Cyclohexanone	14	0.00714
19	Dimethyl Formamide	14	0.000954
20	HSD BS IV	14	0.134
21	*iso*-Nonanol	14	0.00127
22	LAB	14	0.00000290
23	MEG	14	0.000449
24	Propylheptanol	14	0.0000104
25	Styrene Monomer	14	0.108

The calculations summary for the above mentioned products (except that for Base Oil) is given on the appended pages. Calculations were not performed for Base Oil because the Total Loss (kg/day) was reported to be **0**.

Acetone (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.914	kg/day
Q	1.058E+04	μg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
y	0	m
z	0	m
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0607	μg/m^3 ... from Eq. (3)

Butyl Acetate (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0144	kg/day
Q	1.661E+02	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000953	μg/m^3 ... from Eq. (3)

Ethyl Acetate (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.075	kg/day
Q	8.683E+02	µg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00498	µg/m^3 ... from Eq. (3)

Ethanol (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.243	kg/day
Q	2.817E+03	μg/s
α	0.25	
ū	1.62	m/s
$ū_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $ū_1$
b	0.0579	Parameter in Eq. (2): depends on $ū_1$
p	1.09	Parameter in Eq. (2): depends on $ū_1$
$σ_y$	211.124	m ... from Eq. (2)
$σ_z$	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0162	$μg/m^3$ ... from Eq. (3)

Isopropyl Alcohol (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0425	kg/day
Q	4.916E+02	µg/s
α	0.25	
ū	1.62	m/s
$ū_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $ū_1$
b	0.0579	Parameter in Eq. (2): depends on $ū_1$
p	1.09	Parameter in Eq. (2): depends on $ū_1$
$σ_y$	211.124	m ... from Eq. (2)
$σ_z$	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00282	µg/m^3 ... from Eq. (3)

Methyl Ethyl Ketone (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0127	kg/day
Q	1.473E+02	µg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000845	µg/m^3 ... from Eq. (3)

Methanol (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.602	kg/day
Q	6.970E+03	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0400	$\mu g/m^3$ ... from Eq. (3)

Mixed Xylene (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0179	kg/day
Q	2.073E+02	μg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00119	μg/m^3 ... from Eq. (3)

MS BS IV (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	1.73	kg/day
Q	2.003E+04	μg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.115	$\mu g/m^3$ ... from Eq. (3)

n-Butanol (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.000453	kg/day
Q	5.249E+00	μg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0000301	μg/m^3 ... from Eq. (3)

Ortho Xylene (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.006469	kg/day
Q	7.487E+01	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000429	μg/m^3 ... from Eq. (3)

Toluene (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.2412	kg/day
Q	2.792E+03	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0160	μg/m^3 ... from Eq. (3)

VAM (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.04	kg/day
Q	5.132E+02	μg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00294	$\mu g/m^3$ ... from Eq. (3)

Acetic Acid (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.198	kg/day
Q	2.292E+03	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0131	µg/m^3 ... from Eq. (3)

Acetic Anhydride (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.000366	kg/day
Q	4.241E+00	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0000243	µg/m^3 ... from Eq. (3)

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Alpha Olefin C-14 (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0000826	kg/day
Q	9.559E-01	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00000548	μg/m^3 ... from Eq. (3)

Cyclohexanone (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.00714	kg/day
Q	8.267E+01	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000474	µg/m^3 ... from Eq. (3)

Dimethyl Formamide (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.000954	kg/day
Q	1.104E+01	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0000633	µg/m^3 ... from Eq. (3)

HSD (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	*m (mandatory parameter in Eq. (1)*
Q	0.134	kg/day
Q	1.551E+03	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00890	$\mu g/m^3$ ... from Eq. (3)

Isononanol (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.00127	kg/day
Q	1.466E+01	µg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000	µg/m^3 ... from Eq. (3)

LAB (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.00000290	kg/day
Q	3.356E-02	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000000192	μg/m^3 ... from Eq. (3)

MEG (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.000449	kg/day
Q	5.198E+00	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0000298	μg/m^3 ... from Eq. (3)

Propyl Heptanol (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	1.043E-05	kg/day
Q	1.207E-01	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000000692	μg/m^3 ... from Eq. (3)

Styrene Monomer (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.108	kg/day
Q	1.250E+03	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00717	$\mu g/m^3$ ... from Eq. (3)

Appendix 2 – Summary of calculation of VOC concentration (Sea Lord TANKER GANTRY)

$$\begin{cases} \bar{u}_1 = \bar{u}\left(\frac{z_1}{H}\right)^{\alpha} \quad ... \ (Eq.\ 1) \\ \alpha = 0.5 \ \textit{for stable conditions}; \ \alpha = 0.25 \ \textit{for unstable conditions} \end{cases}$$

$$\begin{Bmatrix} \sigma_y = \textit{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z = \textit{speading coefficient} = b \cdot x^{p} \end{Bmatrix} \quad ... \ (Eq.\ 2)$$

$$\langle\rho\rangle(x,\ y,\ z,\ H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\textit{horizontal component}}\right]$$

$$\cdot \left\{\underbrace{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]}_{\textit{vertical component}}\right\} \quad ... \ (Eq.\ 3)$$

$x = $ *logitudinal straight distance from the source tank* (m)

$y = $ *horizonal component from the source tank* $= 0$

$z = $ *vertical component from the source tank* $= 0$

$H = $ *tank height*

$Q = $ *source strength of VOC* $(\mu g/s)$

$\bar{u} = $ *corrected velocity in* x*-direction* (m/s)

$\rho = $ *VOC concentration* $\left(\mu g/m^3\right)$

Basis of calculations:
1. The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
2. Wind velocity data given by Sea Lord, and Aegis Terminal as per weather monitoring station provided at sites.
3. Strong solar radiation and unstable air conditions are assumed.

The Sea Lord tanker loading loss data is as follows:

Sr. No.	Product	Tanker Loading Gantry Vapour Control System Vent Pipe height (mtr)	*Loading Loss (kg/day)
1	Ethyl Alcohol Den.	14	0.246
2	Methanol	14	1.484
3	**Base Oil EHC**	**14**	**0**
4	**Base Oil Ultra2**	**14**	**0**
5	**Base Oil SN 500**	**14**	**0**
6	**Caustic**	**14**	**0**
7	LAB	14	9.063E-05
8	n-Paraffin	14	0.00416
9	Styrene Monomer	14	0.00208

The calculations summary for the above mentioned products (except that for Base Oil) is given on the appended pages. Calculations were not performed for Base Oil EHC, Base Oil Ultra2, Base Oil SN 500, and Caustic, because the Total Loss (kg/day) in all these cases was reported to be **0**.

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Ethanol (Sea Lord Tanker Gantry)		
H (vent pipe)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.246	kg/day
Q	2.848E+03	µg/s
α	0.25	
$\bar{u}$	1.01	m/s
$\bar{u}_1$	0.93	m/s
x	215	m (distance from Sea Lord)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.119	Parameter in Eq. (2): depends on $\bar{u}_1$
p	0.986	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	37.672	m ... from Eq. (2)
σ_z	23.732	m ... from Eq. (2)
ρ (VOC concentration)	0.844	µg/m^3 ... from Eq. (3)

Methanol (Sea Lord Tanker Gantry)		
H (vent pipe)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	1.484	kg/day
Q	1.718E+04	μg/s
α	0.25	
$\bar{u}$	1.01	m/s
$\bar{u}_1$	0.93	m/s
x	215	m (distance from Sea Lord)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.119	Parameter in Eq. (2): depends on $\bar{u}_1$
p	0.986	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	37.672	m ... from Eq. (2)
σ_z	23.732	m ... from Eq. (2)
ρ (VOC concentration)	5.088	μg/m^3 ... from Eq. (3)

LAB (Sea Lord Tanker Gantry)		
H (vent pipe)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	9.063E-05	kg/day
Q	1.049E+00	μg/s
α	0.25	
$\bar{u}$	1.01	m/s
$\bar{u}_1$	0.93	m/s
x	215	m (distance from Sea Lord)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.119	Parameter in Eq. (2): depends on $\bar{u}_1$
p	0.986	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	37.672	m ... from Eq. (2)
σ_z	23.732	m ... from Eq. (2)
ρ (VOC concentration)	0.000311	μg/m^3 ... from Eq. (3)

n-Parafiin (Sea Lord Tanker Gantry)		
H (vent pipe)	14	m
z_1	10	m (mandatory parameter in Eq. (1))
Q	0.00416	kg/day
Q	4.810E+01	µg/s
α	0.25	
$\bar{u}$	1.01	m/s
$\bar{u}_1$	0.93	m/s
x	215	m (distance from Sea Lord)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.119	Parameter in Eq. (2): depends on $\bar{u}_1$
p	0.986	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	37.672	m ... from Eq. (2)
σ_z	23.732	m ... from Eq. (2)
ρ (VOC concentration)	0.0142	µg/m^3 ... from Eq. (3)

Styrene Monomer (Sea Lord Tanker Gantry)		
H (vent pipe)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.00208	kg/day
Q	2.403E+01	µg/s
α	0.25	
ū	1.01	m/s
$\bar{u}_1$	0.93	m/s
x	215	m (distance from Sea Lord)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.119	Parameter in Eq. (2): depends on $\bar{u}_1$
p	0.986	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	37.672	m ... from Eq. (2)
σ_z	23.732	m ... from Eq. (2)
ρ (VOC concentration)	0.00712	µg/m^3 ... from Eq. (3)

Appendix 2 - VOC concentration - Aegis ETP

$$\begin{cases} \bar{u}_1 = \bar{u}\left(\frac{z_1}{H}\right)^{\alpha} & \ldots\ (Eq.\ 1) \\ \alpha = 0.5 \textit{ for stable conditions};\ \alpha = 0.25 \textit{ for unstable conditions} \end{cases}$$

$$\begin{Bmatrix} \sigma_y = \textit{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z = \textit{speading coefficient} = b \cdot x^{p} \end{Bmatrix} \ldots\ (Eq.\ 2)$$

$$\langle\rho\rangle(x,\ y,\ z,\ H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\textit{horizontal component}}\right]$$

$$\cdot \left\{\underbrace{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]}_{\textit{vertical component}}\right\} \ldots\ (Eq.\ 3)$$

x = *logitudinal straight distance from the source tank* (m)

y = *horizonal component from the source tank* = 0

z = *vertical component from the source tank* = 0

H = *tank height*

Q = *source strength of VOC* ($\mu g/s$)

$\bar{u}$ = *corrected velocity in* x*-direction* (m/s)

ρ = *VOC concentration* ($\mu g/m^3$)

Basis of calculations:

1. The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
2. Wind velocity data given by Sea Lord, and Aegis Terminal as per weather monitoring station provided at sites.
3. Strong solar radiation and unstable air conditions are assumed.
4. Emission point height is taken from ground level considering foundation height and roof nozzle height in addition to tank height.

The Aegis ETP tank emission data is as follows:

Sr. No.	Product	Type of Tank	Tank Ht (mtr)	Emission Point on tank top (mtr)	Total Emission (kg/day)
1	Collection Tank	VFR	4.0	5.0	0.0302
2	Primary Settling Tank	VFR	3.0	4.0	0.0259
3	Equalisation Tank 1	VFR	3.0	4.0	0.0262
4	Equalisation Tank 2	VFR	3.0	4.0	0.0259
5	Buffer Tank	VFR	2.0	3.0	0.0256
6	Sludge Tank	VFR	2.0	3.0	0.0257

The calculations summary is given on the appended pages.

Collection Tank (Aegis ETP)		
H (emission point)	5	m
Tank height	4	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0302	kg/day
Q	3.491E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.93	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00201	µg/m^3 ... from Eq. (3)

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Primary Settling Tank (Aegis ETP)		
H (emission point)	4	m
Tank height	3	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0259	kg/day
Q	2.993E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	2.04	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00172	µg/m^3 ... from Eq. (3)

Equalisation Tank 1 (Aegis ETP)		
H (emission point)	4	m
Tank height	3	m
z_1	10	m (mandatory parameter in Eq. (1))
Q	0.0262	kg/day
Q	3.038E+02	µg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	2.04	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00175	$\mu g/m^3$ ... from Eq. (3)

Equalisation Tank 2 (Aegis ETP)		
H (emission point)	4	m
Tank height	3	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0259	kg/day
Q	3.003E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	2.04	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00173	µg/m^3 ... from Eq. (3)

Buffer Tank (Aegis ETP)		
H (emission point)	3	m
Tank height	2	m
z_1	10	m (mandatory parameter in Eq. (1))
Q	0.0256	kg/day
Q	2.964E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	2.19	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00171	µg/m^3 ... from Eq. (3)

Sludge Tank (Aegis ETP)		
H (emission point)	3	m
Tank height	2	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0257	kg/day
Q	2.977E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	2.19	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00171	µg/m^3 ... from Eq. (3)

Appendix 2 - VOC concentration – Sea Lord ETP

$$\begin{cases} \bar{u}_1 = \bar{u}\left(\dfrac{z_1}{H}\right)^{\alpha} \quad \ldots\ (Eq.\ 1) \\ \alpha = 0.5 \textit{ for stable conditions};\ \alpha = 0.25 \textit{ for unstable conditions} \end{cases}$$

$$\left.\begin{cases} \sigma_y = \textit{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z = \textit{speading coefficient} = b \cdot x^{p} \end{cases}\right\} \ldots\ (Eq.\ 2)$$

$$\langle\rho\rangle(x,\ y,\ z,\ H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\textit{horizontal component}}\right]$$

$$\cdot \left\{\underbrace{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]}_{\textit{vertical component}}\right\} \ldots\ (Eq.\ 3)$$

$x = \textit{logitudinal straight distance from the source tank } (m)$

$y = \textit{horizonal component from the source tank} = 0$

$z = \textit{vertical component from the source tank} = 0$

$H = \textit{tank height}$

$Q = \textit{source strength of VOC } (\mu g/s)$

$\bar{u} = \textit{corrected velocity in } x\textit{-direction } (m/s)$

$\rho = \textit{VOC concentration } \left(\mu g/m^3\right)$

Basis of calculations:
1. The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
2. Wind velocity data given by Sea Lord, and Aegis Terminal as per weather monitoring station provided at sites.
3. Strong solar radiation and unstable air conditions are assumed.
4. Emission point height is taken from ground level considering foundation height and roof nozzle height in addition to tank height.

The Sea Lord ETP tank emission data is as follows:

Sr. No.	Product	Type of Tank	Tank Ht (mtr)	Emission Point on tank Top (mtr)	Total Emission (Kg/day)
1	ETP Feed Tank	VFR	2.49	3.49	0.0223

The calculations summary is given on the appended page.

ETP Feed Tank (Sea Lord ETP)		
H (emission point)	3.49	m
Tank height	2.49	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0223	kg/day
Q	2.577E+02	µg/s
α	0.25	
$\bar{u}$	1.01	m/s
$\bar{u}_1$	1.31	m/s
Part (a)		
x	215	m (distance from Sea Lord)
y	0	m
z	0	m
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.119	Parameter in Eq. (2): depends on $\bar{u}_1$
p	0.986	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	37.672	m ... from Eq. (2)
σ_z	23.732	m ... from Eq. (2)
ρ (VOC concentration)	0.0899	$\mu g/m^3$ ... from Eq. (3)

Appendix 2 - VOC concentration - Aegis TANK EMISSION

$$\begin{cases} \bar{u}_1 = \bar{u}\left(\frac{z_1}{H}\right)^{\alpha} \quad ... \ (Eq.\ 1) \\ \alpha = 0.5 \ \textit{for stable conditions};\ \alpha = 0.25 \ \textit{for unstable conditions} \end{cases}$$

$$\left.\begin{cases} \sigma_y = \textit{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z = \textit{speading coefficient} = b \cdot x^{p} \end{cases}\right\} \quad ... \ (Eq.\ 2)$$

$$\langle\rho\rangle(x,\ y,\ z,\ H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\textit{horizontal component}}\right]$$

$$\cdot \left\{\underbrace{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]}_{\textit{vertical component}}\right\} \quad ... \ (Eq.\ 3)$$

x = *logitudinal straight distance from the source tank* (m)

y = *horizonal component from the source tank* = 0

z = *vertical component from the source tank* = 0

H = *tank height*

Q = *source strength of VOC* ($\mu g/s$)

$\bar{u}$ = *corrected velocity in* x*-direction* (m/s)

ρ = *VOC concentration* ($\mu g/m^3$)

Basis of calculations:

1. The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
2. Wind velocity data given by Sea Lord, and Aegis Terminal as per weather monitoring station provided at sites.
3. Strong solar radiation and unstable air conditions are assumed.
4. Emission point height is taken from ground level considering foundation height and roof nozzle height in addition to tank height.

Aegis tank emission data is as follows:

Sr. No.	Product	Type of Tank	Tank Ht (mtr)	Emission Point on tank Top (mtr)	Total Emission (Kg/day)
1	Acetone	VFR	15	16	97.13
2	Ethyl Acetate	VFR	25	26	11.26
3	Ethyl Alcohol Den.	VFR	25	26	47.97
4	MEK	VFR	10	11	8.36
5	MS BS IV	VFR	20	21	86.81
6	Methanol	VFR	20	21	21.90
7	VAM	VFR	10	11	11.90

8	Acetic Acid	VFR	25	26	43.18
9	Acetic Anhydride	VFR	25	26	0.180
10	Alpha Olefin C-14	VFR	25	26	0.0300
11	**Base Oil**	**VFR**	**25**	**26**	**0**
12	Dimethyl Formamide	VFR	25	26	0.250
13	HSD BS IV	VFR	20	21	19.51
14	*iso*-Nonanol	VFR	25	26	0.350
15	LAB	VFR	25	26	0.00156
16	MEG	VFR	25	26	0.100
17	Styrene Monomer	VFR	15	16	22.66
18	Propylheptanol	VFR	25	26	0.00230

The calculations summary for the above mentioned products (except that for Base Oil) is given on the appended pages. Calculations were not performed for Base Oil because the Total Loss (kg/day) was reported to be **0**.

Acetone (Aegis Tank)		
H (emission point)	16	m
Tank height	15	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	97.13	kg/day
Q	1.124E+06	μg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.44	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	6.44	μg/m^3 ... from Eq. (3)

Ethyl Acetate (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	11.26	kg/day
Q	1.303E+05	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.74	µg/m^3 ... from Eq. (3)

Ethanol (Aegis Tank)		
H (emission point)	26	m
Tank height	25	
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	47.97	kg/day
Q	5.552E+05	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	3.2	$\mu g/m^3$ ... from Eq. (3)

Methyl Ethyl Ketone (Aegis Tank)		
H (emission point)	11	m
Tank height	10	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	8.36	kg/day
Q	9.676E+04	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.58	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.56	$\mu g/m^3$ ... from Eq. (3)

MS BS IV (Aegis Tank)		
H (emission point)	21	m
Tank height	20	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	86.81	kg/day
Q	1.005E+06	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.35	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	5.74	μg/m^3 ... from Eq. (3)

Methanol (Aegis Tank)		
H (emission point)	21	m
Tank height	20	
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	21.90	kg/day
Q	2.535E+05	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.35	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	1.4	µg/m^3 ... from Eq. (3)

VAM (Aegis Tank)		
H (emission point)	11	m
Tank height	10	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	11.90	kg/day
Q	1.377E+05	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.58	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.79	µg/m^3 ... from Eq. (3)

Acetic Acid (Aegis Tank)		
H (emission point)	26	M
Tank height	25	M
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	43.18	kg/day
Q	4.998E+05	µg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	2.84	µg/m^3 ... from Eq. (3)

Acetic Anhydride (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	0.180	kg/day
Q	2.083E+03	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.01	μg/m^3 ... from Eq. (3)

Alpha Olefin C-14 (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	0.0300	kg/day
Q	3.472E+02	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00	$\mu g/m^3$ ... from Eq. (3)

Dimethyl Formamide (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	0.250	kg/day
Q	2.894E+03	μg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0164	μg/m^3 ... from Eq. (3)

HSD (Aegis Tank Emission): 2019		
H (emission point)	21	m
Tank height	20	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	19.51	kg/day
Q	2.258E+05	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.35	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	1.29	$\mu g/m^3$ ... from Eq. (3)

Isononanol (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	0.350	kg/day
Q	4.051E+03	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.023	μg/m^3 ... from Eq. (3)

LAB (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	0.00156	kg/day
Q	1.800E+01	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00010	µg/m^3 ... from Eq. (3)

MEG (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	0.100	kg/day
Q	1.157E+03	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0066	μg/m^3 ... from Eq. (3)

Styrene Monomer (Aegis Tank)		
H (emission point)	16	m
Tank height	15	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	22.66	kg/day
Q	2.623E+05	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.44	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	1.50	µg/m^3 ... from Eq. (3)

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Propyl Heptanol (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	0.00230	kg/day
Q	2.662E+01	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000151	μg/m^3 ... from Eq. (3)

Appendix 2 - VOC concentration – Sea Lord TANK EMISSION

$$\begin{cases} \bar{u}_1 = \bar{u}\left(\dfrac{z_1}{H}\right)^{\alpha} \quad \ldots\ (Eq.\ 1) \\ \alpha = 0.5 \textit{ for stable conditions};\ \alpha = 0.25 \textit{ for unstable conditions} \end{cases}$$

$$\left\{\begin{matrix} \sigma_y = \textit{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z = \textit{speading coefficient} = b \cdot x^{p} \end{matrix}\right\} \quad \ldots\ (Eq.\ 2)$$

$$\langle\rho\rangle(x,\ y,\ z,\ H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\textit{horizontal component}}\right]$$

$$\cdot \left\{\underbrace{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]}_{\textit{vertical component}}\right\} \quad \ldots\ (Eq.\ 3)$$

$x = \textit{logitudinal straight distance from the source tank}\ (m)$

$y = \textit{horizonal component from the source tank} = 0$

$z = \textit{vertical component from the source tank} = 0$

$H = \textit{tank height}$

$Q = \textit{source strength of VOC}\ (\mu g/s)$

$\bar{u} = \textit{corrected velocity in x-direction}\ (m/s)$

$\rho = \textit{VOC concentration}\ \left(\mu g/m^3\right)$

Basis of calculations:

1. The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
2. Wind velocity data given by Sea Lord, and Aegis Terminal as per weather monitoring station provided at sites.
3. Strong solar radiation and unstable air conditions are assumed.
4. Emission point height is taken from ground level considering foundation height and roof nozzle height in addition to tank height.

Aegis tank emission data is as follows:

Sr. No.	Product	Type of Tank	Tank Ht (mtr)	Emission Point on tank Top (mtr)	Total Emission (Kg/day)
1	LAB	VFR	20	21	0.0196
2	**Base Oil EHC**	**VFR**	**20**	**21**	**0**
3	**Base Oil Ultra2**	**VFR**	**20**	**21**	**0**
4	**Base Oil SN 500**	**VFR**	**20**	**21**	**0**
5	Styrene Monomer	VFR	20	21	0.0836

The calculations summary for the above mentioned products (except that for Base Oil) is given on the appended pages. Calculations were not performed for Base Oil EHC, Base Oil Ultra2, and Base Oil SN 500, because the Total Loss (kg/day) in these cases was reported to be 0.

LAB (Sea Lord)		
H (emission point)	21	m
Tank height	20	m
z_1	*10*	*m (mandatory parameter in Eq. (1))*
Q	0.0196	kg/day
Q	2.269E+02	µg/s
α	0.25	
ū	1.01	m/s
$\bar{u}_1$	0.84	m/s
x	215	m (distance from Sea Lord)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.119	Parameter in Eq. (2): depends on $\bar{u}_1$
p	0.986	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	37.672	m ... from Eq. (2)
σ_z	23.732	m ... from Eq. (2)
ρ (VOC concentration)	0.0541	$\mu g/m^3$ ... from Eq. (3)

Styrene Monomer (Sea Lord)		
H (emission point)	21	m
Tank height	20	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0836	kg/day
Q	9.679E+02	μg/s
α	0.25	
$\bar{u}$	1.01	m/s
$\bar{u}_1$	0.84	m/s
x	215	m (distance from Sea Lord)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.119	Parameter in Eq. (2): depends on $\bar{u}_1$
p	0.986	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	37.672	m ... from Eq. (2)
σ_z	23.732	m ... from Eq. (2)
ρ (VOC concentration)	0.231	μg/m^3 ... from Eq. (3)

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ANNEXURE R2/2

INSTITUTE OF CHEMICAL TECHNOLOGY रसायन तंत्रज्ञान संस्था
Campuses - Matunga, Mumbai • IOC Bhubaneswar, Odisha • Marathwada, Jalna
Category I Deemed to be University (MHRD/UGC) A++ Grade by NAAC (CGPA 3.77)
Elite Status and Centre of Excellence–Govt. of Maharashtra

Dr. Anand V. Patwardhan
Ph.D. (Tech) Chem. Eng.
Professor of Chemical Engineering
Chief - Industrial Training and Placement

30 April 2020

To,
Aegis Logistics Ltd.
Plot No.72,Mahul Village
Trombay,Chembur
Mumbai- 400 074

Kind Attn : Mr. K.S.Sawant,President- Operations & Projects

Dear Sir,

Subject: Tank Emissions Inventory as per AP-42

As per AP-42 Chapter 7 for emission control from fixed roof tanks, there are several vapour emission control procedures that may be used, including "*vapour/liquid absorption, vapour compression, vapour cooling, vapour/solid adsorption, or a combination of these*".
As mentioned in AP-42 standard reference, US EPA standard EPA-453/R-94-001, a 95% vapour emission efficiency may be applied for Carbon Adsorption system fitted to Fixed Roof tanks.

Consistent with our report of May 2015 to NGT by whom we were appointed in connection with the Application no. 40/2015 (WZ), we have verified that your fixed roof tanks are designed as per API-650 Standard and provided with vapour emission control measures of Carbon Adsorption system.

On this basis, we have re-calculated the tank emission estimates per AP-42 on the product handling data supplied by you and assuming 95% vapour emission reduction efficiency for Carbon Adsorption system as per US EPA Standard EPA-453/R-94-001, we have revised the Tank Emissions calculations sheets after applying the control measures already in place and which were not included in the earlier estimates.

- Contd.

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INSTITUTE OF CHEMICAL TECHNOLOGY रसायन तंत्रज्ञान संस्था
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Dr. Anand V. Patwardhan
Ph.D. (Tech) Chem. Eng.
Professor of Chemical Engineering
Chief - Industrial Training and Placement

Please find attached the revised Tank Emission estimates, duly certified by the Institute.

Thanking you

Yours faithfully,

For **Institute of Chemical Technology**

Encl: As above

Dr. Anand V. Patwardhan
Ph.D. (Tech.) Chemical Engineering
Professor of Chemical Engineering
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AEGIS LOGISTICS LIMITED - TANK EMISSION

Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Diameter	Tank Height	Tank Height	Liquid Height	Tank Capacity	Turnover per year	Throughput	Product withdrawal shell clingage factor	density of product	density of product	Zero Wind speed rim seal loss factor	Wind speed dependent rim seal loss factor	Average ambient wind speed	Seal wind speed exponent	True Vapor Pressure	True Vapor Pressure	Atmospheric pressure	Vapor Pressure function	Molecular weight of vapor	Vapor space volume	stock vapor density	Vapor space expansion factor	vented vapor saturatin factor	Total Deck fitting loss factor	Turn over factor	Working loss product factor	Liquid surface temp	Product Factor	Standing loss	Working loss	Emission Reduction Efficiency Vapour Control System	Total loss	Total loss
			(m)	(ft)	(m)	(ft)	(ft)		/yr	bbl/yr	bbl/1000ft2	Kg/m3	lb/gal	(lbmole/ft-yr)	(lbmole/(mph)^n-ft-yr)	mph	-	mmHg	psia	psia	-	lb/lbmole		lb/ft3			lb-mole/yr			celsius	-	*Note 1	*Note2	%	LT	LT
				D		H	H'	KL	N	Q	C	Rho	WL	KRa	KRb	v	n	PVA	PVA	PA	P*	Mv	VV	Wv	KE	KS	FF	KN	kp		Kc	Ls	Lw	%	lb/yr	kg/day
MEK	VFR TANK			41.01		32.97	29.4	1250	2.13	16778.9893	NA	784	6.54	NA	NA	4.8	NA	89.92	1.738	14.7	0.0314	72.1	5288.88	0.02176085	0.167	0.66	NA	1	1	25	NA	4630.127	2102.758	95	336.64	0.42
VAM	VFR TANK								3.56	27995.7757	NA	917.1	7.65	NA	NA	4.8	NA	114.611	2.215	14.7	0.0408	86.09	5288.88	0.03311794	0.081	0.82	NA	1	1	25	NA	4246.379	5339.534	95	479.30	0.59
STYRENE MONOMER	VFR TANK			68.90		49.22	46.92	5000	15.73	494601.763	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	11239.46	0.00232584	0.016	0.98	NA	1	1	25	NA	149.611	6624.944	95	338.73	0.42
STYRENE MONOMER	VFR TANK			68.9		49.22	47.41	5000	11.79	370824.867	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	9404.45	0.00232584	0.016	0.98	NA	1	1	25	NA	125.1847	4967.014	95	254.61	0.32
ACETONE	VFR TANK			68.9		49.22	46.52	5000	4.92	154784.458	NA	778.25	6.49	NA	NA	4.8	NA	229.698	4.440	14.7	0.0897	58.08	12707.47	0.04477836	0.362	0.51	NA	1	1	25	NA	38344.13	39915.63	95	3912.99	4.86
MEG	VFR TANK								0.26	8275.62728	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	12707.47	1.25E-05	0.041	1	NA	1	1	25	NA	2.377131	0.595752	95	0.15	0.00
STYRENE MONOMER	VFR TANK			68.9		49.22	47.08	5000	14.84	466834.827	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	10627.79	0.00232584	0.016	0.98	NA	1	1	25	NA	141.4689	6253.02	95	319.72	0.40
HSD BS 4	VFR TANK			85.31		65.62	61.52	10000	11.04	694370.325	NA	818.75	6.83	NA	NA	4.8	NA	10	0.193	14.7	0.0033	90	28519.24	0.00302083	0.07	0.93	NA	1	1	25	NA	2047.098	12079.96	95	706.35	0.88
MS BSIV	VFR TANK								0.80	50193.4039	NA	707.66	5.90	NA	NA	4.8	NA	245.9	4.753	14.7	0.0973	68	28519.24	0.05612441	0.209	0.44	NA	1	1	25	NA	53725.63	16223.55	95	3497.46	4.34
ETHYL ALCOHOL DEN.	VFR TANK			85.31		65.62	60.66	10000	3.18	200255.954	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	33432.36	0.00913256	0.137	0.68	NA	1	1	25	NA	10382.02	10532.35	95	1045.72	1.30
HSD BS 4	VFR TANK								1.00	62699.4015	NA	818.75	6.83	NA	NA	4.8	NA	10	0.193	14.7	0.0033	90	7092.13	0.00302083	0.07	0.92	NA	1	1	25	NA	503.596	1090.781	95	79.72	0.10
METHANOL	VFR TANK								2.69	169432.331	NA	780.7	6.51	NA	NA	4.8	NA	127.039	2.456	14.7	0.0457	32.04	7092.13	0.01366199	0.226	0.54	NA	1	1	25	NA	4316.042	13330.85	95	882.34	1.10
BASE OIL	VFR TANK			46.59		65.62	61.95	3000	6.62	124972.066	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	7092.13	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
ETHYL ACETATE	VFR TANK			19.03		82.03	74.38	640	0.94	3803.46864	NA	887.5	7.40	NA	NA	4.8	NA	94.3087	1.823	14.7	0.0331	88.1	2230.69	0.02788766	0.158	0.51	NA	1	1	25	NA	1829.664	610.8567	95	122.03	0.15
ISONONANOL	VFR TANK								0.70	2809.77623	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2230.69	0.00022273	0.043	0.99	NA	1	1	25	NA	7.720009	3.604137	95	0.57	0.00
BASE OIL	VFR TANK			22.64		82.03	79.07	900	7.62	43160.7694	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			22.64		82.03	79.07	900	5.90	33417.9731	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								0.92	5229.8124	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			22.97		82.03	80.38	930	2.87	16778.7062	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	778.75	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
ISONONANOL	VFR TANK			19.69		82.03	80.38	685	3.86	16634.8586	NA	826.7	6.895	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	561.74	0.00022273	0.043	1	NA	1	1	25	NA	1.963716	21.33775	95	1.17	0.00
PROPYLHEPTANOL	VFR TANK								3.27	14082.589	NA	811	6.76	NA	NA	4.8	NA	0.04	0.001	14.7	0.0000	158.3	561.74	2.1253E-05	0.043	1	NA	1	1	25	NA	0.187379	1.723675	95	0.10	0.00
ACETIC ACID	VFR TANK			36.09		82.025	79.15	2300	12.10	175029.446	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	3321.6	0.00309994	0.072	0.94	NA	1	1	25	NA	254.3632	3124.729	95	168.95	0.21
ISONONANOL	VFR TANK								1.06	15310.6301	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	3321.6	0.00022273	0.043	1	NA	1	1	25	NA	11.61156	19.63915	95	1.56	0.00
MEG	VFR TANK								0.93	13432.9787	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	3321.6	1.25E-05	0.041	1	NA	1	1	25	NA	0.621357	0.967024	95	0.08	0.00
ACETIC ACID	VFR TANK			26.25		82.025	78.42	1200	5.11	38537.0788	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2100.86	0.00309994	0.072	0.92	NA	1	1	25	NA	157.4577	687.9866	95	42.27	0.05
ACETIC ANHYDRIDE	VFR TANK								0.80	5841.53853	NA	1050	8.76	NA	NA	4.8	NA	5.253	0.102	14.7	0.0017	102.09	2100.86	0.00180001	0.06	0.98	NA	1	1	25	NA	81.16004	60.55496	95	7.09	0.01
ALPHAOLEFINC-14	VFR TANK								1.33	10023.9666	NA	910	7.59	NA	NA	4.8	NA	0.16	0.003	14.7	0.0001	196	2100.86	0.00010526	0.041	1	NA	1	1	25	NA	3.309285	6.076416	95	0.47	0.00
ETHYL ALCOHOL DEN.	VFR TANK								0.73	5508.25821	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2100.86	0.00913256	0.137	0.76	NA	1	1	25	NA	729.1495	289.7038	95	50.94	0.06
MEG	VFR TANK								2.24	16872.5656	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	2100.86	1.25E-05	0.041	1	NA	1	1	25	NA	0.392999	1.214636	95	0.08	0.00
ACETIC ACID	VFR TANK			27.89		82.025	75.23	1375	5.08	43923.6105	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	4326.21	0.00309994	0.072	0.87	NA	1	1	25	NA	306.6238	784.1502	95	54.54	0.07
ETHYL ACETATE	VFR TANK								2.07	17890.4945	NA	887.5	7.40	NA	NA	4.8	NA	94.3087	1.823	14.7	0.0331	88.1	4326.21	0.02788766	0.158	0.54	NA	1	1	25	NA	3757.191	2873.306	95	331.52	0.41
ETHYL ALCOHOL DEN.	VFR TANK								0.93	8010.22498	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4326.21	0.00913256	0.137	0.64	NA	1	1	25	NA	1264.426	421.2934	95	84.29	0.10
MEG	VFR TANK								0.80	6925.17708	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4326.21	1.25E-05	0.041	1	NA	1	1	25	NA	0.809285	0.498535	95	0.07	0.00
DIMETHYL FORMAMIDE	VFR TANK			32.81		82.025	79.3	1900	2.34	27941.376	NA	937.9	7.82	NA	NA	4.8	NA	3.995	0.077	14.7	0.0013	73.05	2591.4	0.00097954	0.044	0.98	NA	1	1	25	NA	39.95098	157.6219	95	9.88	0.01
ACETIC ACID	VFR TANK			32.81		82.025	79.4	1900	9.85	117722.142	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2508.18	0.00309994	0.072	0.94	NA	1	1	25	NA	192.0727	2101.645	95	114.69	0.14
ISONONANOL	VFR TANK								0.36	4278.0683	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2508.18	0.00022273	0.043	1	NA	1	1	25	NA	8.768031	5.487535	95	0.71	0.00
MEG	VFR TANK								2.58	30795.587	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	2508.18	1.25E-05	0.041	1	NA	1	1	25	NA	0.469194	2.216937	95	0.13	0.00
BASE OIL	VFR TANK			49.22		82.025	80.06	4300	1.08	29217.6741	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								0.55	14755.9485	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								2.22	59993.6949	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								0.68	18330.3514	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								1.07	28857.9567	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								0.56	15068.3937	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	1.31	18911.74	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			32.81		82.025	80.06	1900	3.74	44701.1906	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1953.37	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
ALPHAOLEFINC-14	VFR TANK			49.22		82.025	80.06	4300	0.46	12490.934	NA	910	7.59	NA	NA	4.8	NA	0.16	0.003	14.7	0.0001	196	4720.17	0.00010526	0.041	1	NA	1	1	25	NA	7.435236	7.571864	95	0.75	0.00
ETHYL ALCOHOL DEN.	VFR TANK								2.53	68559.8964	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4720.17	0.00913256	0.137	0.84	NA	1	1	25	NA	1810.685	3605.87	95	270.83	0.34
LAB	VFR TANK								0.28	7592.80797	NA	847.35	7.07	NA	NA	4.8	NA	0.01	0.000	14.7	0.0000	326.49	4720.17	1.0959E-05	0.041	1	NA	1	1	25	NA	0.774085	0.479186	95	0.06	0.00
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	5.41	78333.6946	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
ISONONANOL	VFR TANK			36.09		82.025	80.06	2300	8.59	124242.556	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2398.54	0.00108079	0.043	1	NA	1	1	25	NA	40.68633	159.3676	95	10.00	0.01
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	1.64	23777.504	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			33.63		82.025	80.06	2000	2.78	34956.9327	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2059.85	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
MEG	VFR TANK			49.22		82.025	80.06	4300	10.28	278142.765	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	20.02316	95	1.05	0.00
ETHYL ALCOHOL DEN.	VFR TANK			49.22		82.025	80.06	4300	1.63	44039.4846	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4720.17	0.00913256	0.137	0.84	NA	1	1	25	NA	1810.685	2316.233	95	206.35	0.26
MEG	VFR TANK								6.30	170272.396	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	12.2577	95	0.66	0.00
ACETIC ACID	VFR TANK			36.09		82.025	80.06	2300	14.00	202488.469	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2398.54	0.00309994	0.072	0.95	NA	1	1	25	NA	185.6306	3614.943	95	190.03	0.24
ETHYL ALCOHOL DEN.	VFR TANK								1.01	14609.1731	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2398.54	0.00913256	0.137	0.84	NA	1	1	25	NA	920.0938	768.3615	95	84.42	0.10
MEG	VFR TANK			49.22		82.025	80.06	4300	9.95	269225.807	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	19.38124	95	1.01	0.00
ACETIC ACID	VFR TANK			39.37		82.025	80.38	2800	15.31	269710.398	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2496.62	0.00309994	0.072	0.96	NA	1	1	25	NA	195.2553	4815.029	95	250.51	0.31
ETHYL ALCOHOL DEN.	VFR TANK								0.95	16809.8078	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2496.62	0.00913256	0.137	0.86	NA	1	1	25	NA	980.5207	884.1027	95	93.23	0.12
ACETIC ACID	VFR TANK			41.01		82.025	80.22	3000	16.27	306944.808	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2948.3	0.00309994	0.072	0.96	NA	1	1	25	NA	230.5802	5479.759	95	285.52	0.35
ETHYL ALCOHOL DEN.	VFR TANK								0.79	14864.3478	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2948.3	0.00913256	0.137	0.86	NA	1	1	25	NA	1157.913	781.7823	95	96.98	0.12
ACETIC ACID	VFR TANK			49.22		82.025	80.06	4300	16.90	457033.683	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	4720.17	0.00309994	0.072	0.95	NA	1	1	25	NA	365.3089	8159.234	95	426.23	0.53
MEG	VFR TANK			49.22		82.025	80.06	4300	8.76	237002.322	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	17.06151	95	0.90	0.00
ACETIC ACID	VFR TANK			36.09		82.025	80.06	2300	15.30	221351.66	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2398.54	0.00309994	0.072	0.95	NA	1	1	25	NA	185.6306	3951.7	95	206.87	0.26
																																			14970.3	18.58

Note: The Fixed Roof Storage tank Emission Calculation are based on AP- 42 Chapter 7 with 95% Emission reduction efficiency for Carbon Adsorption vapour control system provided by the company. (after PV Valve)

Note 1: Standing loss=365* Vv*Wv*Ke*Ks

Note 2: Working loss=0.001*Mv*Q*Pv*Kn*Kp

Above method is verified by ICT,Mumbai,Chemical Engg. Dept.

Note 3: Out of All above products, Hazardous Air Pollutants (HAP's) as per US EPA are only following--

Product	Tank Emission (kg/day)	EPA classification as Carcinogenic from Inhalation
Styrene Monomer	1.14	No
Methanol	1.1	No
VAM	0.59	No
Dimethyl Formamide	0.01	No
TOTAL	2.84	

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Professor of Chemical Engineering
Chief - Industrial Training and Placement

30 April 2020

To,
Sea Lord Containers Ltd.
Ambapada,Mahul Village
Near BPCL Refinery Main Gate
Chembur,Mumbai- 400 074

Kind Attn : Mr. K.S.Sawant,President- Operations & Projects

Dear Sir,

Subject: Tank Emissions Inventory as per AP-42

As per AP-42 Chapter 7 for emission control from fixed roof tanks, there are several vapour emission control procedures that may be used, including "*vapour/liquid absorption, vapour compression, vapour cooling, vapour/solid adsorption, or a combination of these*".
As mentioned in AP-42 standard reference, US EPA standard EPA-453/R-94-001, a 95% vapour emission efficiency may be applied for Carbon Adsorption system fitted to Fixed Roof tanks.

Consistent with our report of May 2015 to NGT by whom we were appointed in connection with the Application no. 40/2015 (WZ), we have verified that your fixed roof tanks are designed as per API-650 Standard and provided with vapour emission control measures of Carbon Adsorption system.

On this basis, we have re-calculated the tank emission estimates per AP-42 on the product handling data supplied by you and assuming 95% vapour emission reduction efficiency for Carbon Adsorption system as per US EPA Standard EPA-453/R-94-001, we have revised the Tank Emissions calculations sheets after applying the control measures already in place and which were not included in the earlier estimates.

- Contd.

AVP

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Please find attached the revised Tank Emission estimates, duly certified by the Institute.

Thanking you

Yours faithfully,

For **Institute of Chemical Technology**

Encl: As above

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SEA LORD CONTAINERS LTD - TANK EMISSION

Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Height	Liquid Height	Tank Capacity	Turnover per year	Throughput	Product withdrawal shell clingage factor	density of product	density of product	Zero Wind speed rim seal loss factor	Wind speed dependent rim seal loss factor	Average ambient wind speed	Seal wind speed exponent	True Vapor Pressure
			(ft)	(ft)	(ft)		/yr	bbl/yr	bbl/1000ft2	Kg/m3	lb/gal	(lbmole/ft-yr)	(lbmole/(mph)^n-ft-yr)	mph	-	mmHg
			D	H	H'	KL	N	Q	C	Rho	WL	KRa	KRb	v	n	
LAB	VFR TANK		59.06	65.62	64.37	5000	7.55	237310.89	NA	847.35	7.07	NA	NA	4.8	NA	0.01
BASE OIL EHC	VFR TANK		59.06	65.62	64.37	5000	0.96	30146.55	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0
BASE OIL ULTRA2							0.73	22925.55	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0
BASE OIL SN 500							0.45	14011.94	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0
STYRENE MONOMER							0.82	25693.62	NA	896.6	7.48	NA	NA	4.8	NA	6.59

Service	True Vapor Pressure	Atmospheric pressure	Vapor Pressure function	Molecular weight of vapor	Total Deck fitting loss factor	Turn over factor	Working loss product factor	Product Factor	Vented Vapour Space saturation factor	Vapour space Expansion factor	Liquid surface temp.	Vapor space volume	stock vapor density	Standing loss	Working loss	Emission Reduction Efficiency Vapour Control System	Total loss	Total loss
	psia	psia	-	lb/lbmole	lb-mole/yr			-			Degree Celcius	ft3	lb/ft3	*Note 1	*Note 2		LT	LT
	PVA	PA	P*	Mv	FF	KN	KP	Kc	KS	KE		Vv	Wv	Ls	Lw	%	Lb/yrs	KG/day
LAB	0.00019	14.7	0.0000	326.49	NA	1	1	NA	1.000	0.040	25	5099.840	1.0959E-05	0.815935	14.97681	95	0.78963738	0.00098
BASE OIL EHC	0.00	14.7	0.0000	700	NA	1	1	NA	1.000	0.040	25	5099.840	0	0	0	-	0	0
BASE OIL ULTRA2	0.00	14.7	0.0000	700	NA	1	1	NA	1.000	0.040	25	5099.840	0	0	0	-	0	0
BASE OIL SN 500	0.00	14.7	0.0000	700	NA	1	1	NA	1.000	0.040	25	5099.840	0	0	0	-	0	0
STYRENE MONOMER	0.127	14.7	0.0022	105.15	NA	1	1	NA	0.986	0.016	25	5099.840	0.00232584	67.36738	0.01091	95	3.368914532	0.004181
																	4.16	**0.0052**

Note: The Fixed Roof Storage tank Emission Calculation are based on AP- 42 Chapter 7 with 95% Emission reduction efficiency for Carbon Adsorption vapour control system provided by the company. (after PV Valve)

Note 1: Standing loss=365* Vv*Wv*Ke*Ks

Note 2: Working loss=0.001*Mv*Q*Pv*Kn*Kp

Above method is verified by ICT,Mumbai,Chemical Engg. Dept.

Note 3: Out of All above products, Hazardous Air Pollutants (HAP's) as per US EPA are only following--

Products	Tank Emission (kg/day)	EPA classification as Carcinogenic from Inhalation
Styrene Monomer	0.0042	No
TOTAL	**0.0042**	

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ANNEXURE R2/3

12 June 2020

Aegis Logistics Ltd.
Plot No.72,Mahul Village
Trombay,Chembur
Mumbai- 400 074

Kind Attention: Mr. K.S.Sawant, President-Operations & Projects

Dear Sir,

Subject: VOC Emissions Estimation, Dispersion Modeling and Environmental Impact Assessment of your Chemical Storage terminal at Mahul, Mumbai

With reference to above, please find enclosed herewith our study report. Our report is prepared on the basis of the data and assumptions provided by your company and the agreed parameters of the particular matter for which the report is prepared.

Thanking you & with regards,

Yours sincerely,
For **Institute of Chemical Technology**

A Patwardhan

Encl: ICT Report

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VOC Estimation, Dispersion Modeling and Environmental Impact Assessment of Aegis Logistics Ltd, Chemical Storage Terminal.

Prepared By: Institute of Chemical Technology, Mumbai

June 2020

Table of Contents

Executive Summary

This report is an estimation of the emission of VOC's from the Chemical Storage tank farm of Aegis Logistics Ltd. in Mumbai. The report estimates the volume of HAP and VOC (as specified by US EPA and the Ministry of Environment, Forest and Climate Change, Government of India (MoEF & CC)) emissions from the Vertical Fixed Roof (VFR) tanks, the product gantry and effluent treatment plant, models their dispersion and resultant concentrations, and compares them to US EPA reference concentrations for health impacts. The input data has been provided by the client and is identical to that provided to Expert Agency (NEERI) appointed by CPCB. The methodology specified by CPCB (US EPA standard, AP 42 , Chapters 5 and 7) have been used to estimate the daily VOC emissions after control measures in line with the protocol agreed with the CPCB. Thereafter, dispersion modeling was carried out for each product emitted to measure the predicted concentrations of the relevant substance and compared to US EPA reference concentrations to determine if there would be any adverse health effects.

The summary results of Emission quantities are given below:

	Regulatory Standard	
Source of Emission in Kg/Day per AP 42	US EPA[1]	MoEF & CC in GSR 820(E)[2]
Tanks	2.84	6.00
ETP	0.16	0.16
Product Gantry	1.01	1.28
Total	**4.01**	**7.44**

[1] https://www.epa.gov/haps/initial-list-hazardous-air-pollutants-modifications
[2] GSR 820(E) https://parivesh.nic.in/writereaddata/ENV/envstandard/envstandard14.pdf

The results of dispersion modelling, which measures the potential environmental impact on the neighboring communities is shown below.

Sr. No.	Products Classified as HAP by EPA	Vapour Concentration μ gm/m³ in Complainant Area	EPA Health. μ gm/m³	EPA classification as Carcinogen
		Storage Tanks		
1	Styrene Monomer	0.08	1,000	No
2	Methanol	0.07	20,000	No
3	VAM	0.04	200	No
4	Dimethyl Formamide	0.00	30	No
		Product Gantry		
1	Mixed Xylene	0.00	100	No
2	Ortho-Xylene	0.00	100	No
3	Styrene Monomer	0.00	1,000	No
4	Methanol	0.04	20,000	No
5	Toluene	0.02	5,000	No
6	VAM	0.00	200	No
7	Dimethyl Formamide	0.00	30	No
		Effluent Treatment		
1	Effluent	0.00	-	-

From the above table, it is apparent that none of products handled by Aegis which are considered as Hazardous Air Pollutants by US EPA are carcinogenic and the vapour concentrations of these products in the complainant's resident areas would be significantly below the RfC of US EPA.

We conclude that there is unlikely to be any harmful effect on environment or human health of surrounding population in the area on account of air emissions from the Aegis Terminal.

We have also reviewed the CPCB report submitted to the NGT, which is based on calculations and modelling done by NEERI and find important differences in the findings, the probable reasons for which are mentioned on page 7 of this report.

Background

Pursuant to NGT order dated 03.02.2015 in the Application No.40/2014, the NGT had appointed the Institute of Chemical Technology (Mumbai), to carry out an evaluation of the Pollution Control systems installed at Aegis Logistics Ltd. and whether they were adequate to restrict the VOC emissions. Such report was submitted to the court on 16.05.2015 and a final order was passed on 18.12.2015. Subsequently, an Execution application No.05/2018 was filed on 17.04.2018 wherein the Central Pollution Control Board (CPCB) was directed to estimate damages due to the VOC's emitted by Aegis Logistics Limited. After consultation with the industries involved in the estimation and the Applicants on 14.08.2019 at their offices in New Delhi with regards to terms of reference, CPCB appointed M/s NEERI as expert agency to carry out the study. The terms of reference finalized by CPCB are listed in the Minutes of Meeting and the email correspondence of CPCB with NEERI and shared with the respective Industries shown in Annexure 1.

M/s Aegis Logistics Limited have approached the ICT, (a "Elite Status and Centre of Excellence", Government of Maharashtra, and recognized as a University by the Department of Human Resources, Government of India), which has the necessary domain knowledge and familiarity with the subject matter of the Application to carry out a parallel study using the same data as provided to NEERI and produce a final report which will determine the following;

(1) the quantity of VOC's emitted and,

(2) whether the VOC emissions were in such quantities and concentrations so to as to be harmful to the environment and pose a threat to human health.

(3) Review the CPCB report submitted to the NGT containing emission estimates of VOCs, calculation of concentrations and dispersion of VOC's and compare the results with our findings.

We have perused the report submitted by CPCB to the NGT on 18 March 2020 based on the NEERI calculation and find that the emission estimates are different than those calculated by us. The main difference appears to be due to (1) that no adjustment has been made for control measures implemented in the tanks and (2) that all products, irrespective of whether they are classified as VOC's or HAP's have been considered including several products not on the list of products stored or handled. Furthermore, no calculations have been shown for the concentration or dispersion of the VOC's or HAPS for us to comment on the environmental impact.

It would therefore be imperative to receive from CPCB, a full set of assumptions and dispersion calculations for each of the products that so that we may evaluate and comment on any differences between our calculations which are enclosed in this report, and those performed by NEERI on behalf of CPCB.

Applicability of Regulatory Parameters.

The emissions of concern have been identified by the NGT as VOCs. The US EPA, under the Clean Air Act 1990, regulates 187 Hazardous Air Pollutants, (HAPs) which includes VOCs. The Ministry of Environment, Forests & Climate Change (MoEF & CC), Government of India has formulated environmental standards for India :

> *Development of Environmental Standards: The Ministry of Environment, Forest & Climate Change (MoEF&CC) formulates and notifies standards for emission for discharge of environmental pollutants viz. Air pollutants, water pollutants and noise limits, from industries, operations or processes with an aim to protect and improve the quality of the environment and abate environmental pollution.*
>
> Source: http://moef.gov.in/environment/pollution/

The MoEF & CC has listed the VOC's in the Environment (Protection) Fourth Amendment Rules, 2012, through G.S.R. 820(E), w.e.f. 09-11-2012, to further amend the Environment (Protection) Rules, 1986. Furthermore, the Consent to Operate granted to Aegis Logistics Ltd. was modified by the Maharashtra Pollution Control Board pursuant to NGT order dated 15.12.2015 and it specifies the application of GSR 820(E). The GSR 820(E) lists the VOC's which are to be controlled. This Environmental Standard has been notified by the Government of India in the Gazette as lists the relevant VOCs as follows:

Process Emission (General Pollutant)

	Source	Limiting concentration in mg/Nm3
VOC (MA, PA and Phenol)	MA, PA, Phenol Plants	20
VOC (EB, Styrene, Toluene, Xylene, Aromatics, EG and PG)	Ethyl benzene (EB), Styrene, Toluene, Xylene, Aromatics, EG, PG Plants	10
VOC (Paraffin, Acetone and Olefins)	Non-methane, HC (paraffin), Acetone, Olefins Plants	150

Source: https://parivesh.nic.in/writereaddata/ENV/envstandard/envstandard14.pdf

Approach

In order to conduct a parallel study to that conducted by NEERI, it was critical to follow the agreed terms of reference and methodology approved by the CPCB, as well as to use the same data set requested by NEERI (Annexure 2) from the specific industries as well as the same assumptions. Aegis Logistics Ltd. have provided us the same data files as provided to NEERI (Annexure 3). The methodology followed in the study is as follows:

1. Estimate the VOC emissions from all sources inside the Aegis tank terminal in a manner consistent with the Terms of Reference, agreed per the Minutes of Meeting submitted to NGT on 14.08.2019 by CPCB.
    a) *"estimation of VOC's, before and after pollution control measures, as per method AP-42" (Point No. 2 of the minutes of meeting)*
2. Calculate the dispersion of such VOC emissions and resultant concentrations in nearest receptor population (the Applicants).
3. Compare the resultant concentrations with the US EPA reference concentrations (RfC) for adverse health effects, both carcinogenic and non-carcinogenic.
4. Monetary damages estimation to be done if the concentrations of emitted HAPs or VOCs exceed either those which are not permitted by Indian or US EPA environmental and health standards for air emissions.

AP-42 Methodology.

AP-42 is the compilation of Air Pollution Emissions Factors developed by the Environmental Protection Agency of the United States of America. (US EPA). The Fifth Edition of AP-42 was published in January 1995 and has been updated with supplements and updates on the US EPA website. (Source:https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors.)

The general equation for emission estimation is given as:

$$E = A\,x\,EF\,x\left(1 - \frac{ER}{100}\right)$$

where *E* =Emissions, *A*= Activity Rate, *EF* = Emissions Factor, and *ER* = overall emission reduction efficiency, %.(Source: https://www3.epa.gov/ttn/chief/ap42/c00s00.pdf)

Fixed Roof Tanks Emissions.

Chapter 7, Section 7.1.2.1 of AP-42 standard outlines the methodology for estimating emissions from Fixed Roof Tanks before the application of emission controls.

7.1.2.1 Fixed Roof Tanks

The two significant types of routine emissions from fixed roof tanks are standing and working losses. The standing loss mechanism for a fixed roof tank is known as breathing, which is the expulsion of vapor from a tank through vapor expansion and contraction that results from changes in temperature and barometric pressure.

The evaporative loss from filling is called working loss. Emissions due to filling operations are the result of an increase in the liquid level in the tank. As the liquid level increases, the pressure inside the vapor space increases and vapors are expelled from the tank through the vent(s) on the fixed roof as described above for standing loss.

Vapor recovery systems collect emissions from storage tanks and convert them to liquid product. Several vapor recovery procedures may be used, including vapor/liquid absorption, vapor compression, vapor cooling, vapor/solid adsorption, or a combination of these. (Source: https://www3.epa.gov/ttn/chief/ap42/ch07/final/c07s01.pdf)

Routine losses from fixed roof tanks are equal to the sum of the standing loss and working loss in equation 1-1.

$$L_T = L_S + L_W$$

where:

L_T= total routine losses, lb/yr

L_S= standing losses, lb/yr,

L_W= working losses, lb/yr,

where

$$L_S = 365 * V_V * W_V * K_E * K_S$$

and

$$L_W = 0.0010 * M_V * P_{VA} * Q * K_N * K_P$$

This gives the pre-control emission estimates. In accordance with US EPA guidelines, the post control emission estimates are then adjusted for the application of emission/vapor control devices installed on the tanks.

Adjustment for Control Devices

US EPA provides guidance on control efficiency of carbon adsorption vapour control system in Section 4.2.2 of Document EPA-453/R-94-001: (https://www3.epa.gov/airquality/ctg_act/199401_voc_epa453_r-94-001_liquid_storage_roof_tanks.pdf) and the US EPA protocol on VOC emissions estimation for Fixed Roof Tanks fitted with control devices in section 3.2 of the EPA guidelines: . https://www3.epa.gov/ttn/chief/efpac/protocol/Protocol Report 2015.pdf

For fixed-roof tanks that are vented to a control device, but for which flow and composition data are not measured (i.e., data are not available to use Methodology Rank 1for storage tanks), the pre-control emissions from the fixed-roof storage tanks can be estimated using the appropriate equations for fixed- roof storage tanks presented in Chapter 7.1 of AP-42 (U.S. EPA, 1995a). The post-control device emissions are then estimated from the pre-control emission estimates and the efficiency of the control device using ***Equation 3-1***.

$$E_i = E_{unc,i} \times \left[1 - \frac{CD_{eff}}{100\%}\right]$$

where

E_i= Emission rate of pollutant "i" .

$E_{unc,i}$= Projected emission rate of pollutant "i" assuming storage tank or unit does not have an add on control device.

$CD_{eff,i}$= Control Device efficiency for pollutant "i" (weight percent) See Table below:

Table 3-2. Default Control Efficiencies for Different VOC Control Devices

Control Device	Pollutants	Control Device Efficiency
Refrigerated Condenser	All VOC constituents	Variable based on constituents and operating temperature[a]
Thermal oxidizer	All VOC constituents	98%
Catalytic oxidizer	All VOC constituents	98%
Carbon adsorption	VOC constituents other than those listed in table note b	95%
	Constituents listed in table note b	0%

[a] The control efficiency of a condenser should be determined based on the operating conditions of the condenser and composition of the vent stream following the methods *Methods for Estimating Air Emissions from Chemical Manufacturing Facilities* (EIIP, 2007, Section 4.2.3)

[b] The following compounds have extremely low adsorptive capacities on activated carbon: acetaldehyde, acetonitrile, acetylene, bromomethane, chloroethane, chloromethane, ethylene, formaldehyde, methanol, and vinyl chloride.

Source: https://www3.epa.gov/ttn/chief/efpac/protocol/Protocol Report 2015.pdf

The pressure relief valves on Aegis' fixed roof tanks are vented to activated carbon adsorption control devices fitted outside the tanks as per the recommendation report of the Expert Committee appointed by NGT in August 2014[3]. On this basis, consistent

[3] Required by GSR 820(E) which requires 95% efficiency of vapour control from Fixed Roof Tanks.

with US EPA default protocol for carbon adsorption VOC control device, we assume a 95% control efficiency for VOC emissions from Aegis fixed roof tanks.

Detailed calculations product wise and tank wise for Routine Losses from storage tanks are presented in Annexure 4.

Effluent Treatment Plant Emissions.

Emissions from the effluent treatment plant are considered to be the same as a fixed roof tank and calculated as per AP 42. All ETP tanks are covered and an activated carbon adsorber control device has been provided to the ETP collection tank. No adjustment has been made for control efficiency as the emission figures are very low and will not make a material difference. ETP emission estimates are presented in Annexure 4.

Product Gantry Emissions.

Emissions from the Product Loading gantry have been estimated using the AP -42 Chapter 5 using the following equation to estimate pre controlled loading.

$$L_L = 12.46 \frac{S.P.M}{T}$$

where :

L_L = Loading loss, pounds per 1000 gallons (lb/10^3 gal) of liquid loaded
S = A saturation factor
P = True vapor pressure of liquid loaded, pounds per square inch absolute (psia)
M = Molecular weight of vapors, pounds per pound-mole
T = Temperature of bulk liquid loaded, °R (°F + 460)

The pre-control emissions are adjusted for control devices with an assumed control efficiency of 99% as per AP 42 Chapter 5.2.6.

$$L_L = 12.46 \frac{S.P.M}{T}\left(1 - \frac{CD_{eff}}{100}\right)$$

Product Gantry emissions are presented in detail for all products in Annexure 4.

Summary of Emission Estimates.

As per the agreed terms of reference with CPCB, all estimations were done as per AP-42, before and after control measures installed at Aegis terminal, and using AP 42 default efficiency benchmarks for control measures. On this basis, the emission quantity of products classified as HAP as per US EPA or as VOC as per MoEF & CC (GSR 820(E) from VFR tanks, product gantry and ETP are as follows:

	Regulatory Standard	
Source of Emission in Kg/Day after control as per AP 42	US EPA	MoEF & CC in GSR 820(E)
Tanks	2.84	6.00
ETP	0.16	0.16
Product Gantry	1.01	1.28
Total	**4.01**	**7.44**

Health Effects of Emissions.

The US EPA maintains a comprehensive information database of the evaluation of health effects from chronic and short term inhalation of air pollutants, both in terms of non-carcinogenic and carcinogenic health risks of every product listed as a Hazardous Air Pollutant. The HAP's emitted by Aegis through the Storage tanks or Product Gantry are listed below.

Product	EPA Health Sheet	RfC in µg/m^3	Carcinogenic Risk
Mixed Xylene	https://www.epa.gov/sites/production/files/2016-09/documents/xylenes.pdf	100	No
Ortho-Xylene	https://www.epa.gov/sites/production/files/2016-09/documents/xylenes.pdf	100	No
Styrene Monomer	https://www.epa.gov/sites/production/files/2020-05/documents/styrene_update_2a.pdf	1,000	No
Methanol	https://www.epa.gov/sites/production/files/2016-09/documents/methanol.pdf	20,000	No
Toluene	https://www.epa.gov/sites/production/files/2016-09/documents/toluene.pdf	5,000	No
VAM	https://www.epa.gov/sites/production/files/2016-09/documents/vinyl-acetate.pdf	200	No
Dimethyl Formamide	https://www.epa.gov/sites/production/files/2016-09/documents/n-n-dimethylformamide.pdf	30	No

Source: https://www.epa.gov/haps/health-effects-notebook-hazardous-air-pollutants.

Dispersion Modeling methodology.

In order to ascertain whether the HAP or VOC emissions of Aegis pose any environmental risk to the nearby population, we carried out dispersion modeling for each product stored in VFR tanks, loaded at the Product Gantry or emitted from the ETP using fundamental dispersion equations in the methodology prescribed in C.S Rao's "*Environmental Pollution Control Engineering",3rd Edition* incorporating all key variables with certain assumptions based on the factual data provided by Aegis Logistics Ltd. The detailed calculations for each product are shown in Annexure 6. The summary of resultant concentrations at the location of the Applicants of products classified as HAP by the US EPA or as VOC's by GSR 820(E) is compared with the US EPA health effects database for chronic inhalation in the table below since are no comparable Indian reference standards for health effects from chronic inhalation.

Aegis Emission Inventory and Vapour Concentration (EPA)

Sr. No.		Emission in Kg/Day	Vapour Concentration μ gm/m³ in Complainant Area	EPA RfC. μ gm/m³	EPA classification as Carcinogen
Storage Tanks					
1	Styrene Monomer	1.14	0.08	1,000	No
2	Methanol	1.10	0.07	20,000	No
3	VAM	0.59	0.04	200	No
4	Dimethyl Formamide	0.01	0.00	30	No
Product Gantry					
1	Mixed Xylene	0.02	0.00	100	No
2	Ortho-Xylene	0.00	0.00	100	No
3	Styrene Monomer	0.11	0.00	1,000	No
4	Methanol	0.60	0.04	20,000	No
5	Toluene	0.24	0.02	5,000	No
6	VAM	0.04	0.00	200	No
7	Dimethyl Formamide	0.00	0.00	30	No
Effluent Treatment Plant (ETP)					
1	Effluent	0.16	0.00	-	-
	TOTAL	**4.01**	-		

Aegis Emission Inventory and Vapour Concentration per GSR (820(E))

Sr. No.		Emission in Kg/Day	Vapour Concentration μ gm/m^3 in Complainant Area	EPA RfC. μ gm/m^3	EPA classification as Carcinogen
Storage Tanks					
1	Styrene Monomer	1.14	0.08	1,000	No
2	Acetone	4.86	0.32	NOT AVAILABLE	No
Product Gantry					
1	Mixed Xylene	0.02	0.00	100	No
2	Ortho-Xylene	0.00	0.00	100	No
3	Styrene Monomer	0.11	0.00	1,000	No
4	Toluene	0.24	0.02	5,000	No
5	Acetone	0.91	0.06	NOT AVAILABLE	No
Effluent Treatment Plant (ETP)					
1	Effluent	0.16	0.00	-	-
	TOTAL	**7.44**	-	-	-

Conclusion.

From above analysis, we conclude that the emission of VOCs as defined per US EPA from the Aegis storage tanks, product gantry and ETP are in the range of 4 Kg per day. If defined as per MoEF & CC, the VOC emissions are 7.44 Kg per day.

The dispersion modelling of each VOC was carried out and compared with US EPA health reference standards for inhalation on a chronic basis and found to have negligible environmental or health impact whether Indian or US EPA list of VOC is applied.

The calculation of monetary damages does not appear to be relevant since the emissions of VOC's appear to be within standards specified in GSR 820 (E) and the concentrations in the complainant area are negligible.

A N Patwardhan

Annexure 1.

Terms of reference for study of VOC emissions set by CPCB.

Minutes of the meeting held on 14.08.2019 at CPCB as per the Hon'ble NGT order

The NGT order dated 15.07.2019 directed " *The parties including the applicant are liberty to furnish their respective viewpoint to the CPCB on or before 31.07.2019. On 14.08.2019, in the office of CPCB, the parties will be allowed to peruse the viewpoint of each other, including the documents already submitted from 11.00 AM to 1.00 PM*". As per the direction Hon'ble NGT ,a meeting was conducted on 14.08.2019 at CPCB . Representatives of M/S BPCL,M/s HPCL, M/s Sea lord Containers Limited, and M/S Aegis Aegis Logistics Limited were present in the meeting. List of participants is annexed at Annexure-I.

1. Shri Siddharth A. Mehta, Advocate was present on behalf applicants during the meeting on 14.08.2019 and requested to give 15 more days to produce evidence of assessed impact on health and environment in the area of MAHUL i.e up to 31.08.2019. It was suggested to him to get the complaints related to health examined and endorsed by a Medical Practitioner/Doctor.
2. All the units were asked to furnish the complete data for calculation for estimation of VOCs, before & after pollution control measures as per the method AP-42. A questionnaire will be provided to all the 4 units, as soon as finalized by the expert agency. It was decided that the data will be certified by the operating heads of industrial units.
3. It was also directed that all the 4 units will adopt uniform approach for selection of factor for calculation of VOCs.
4. All the units are to submit the ATRs on VOCs controlled with reduction percentage for each source.
5. The damage assessment and amount to be recovered will be calculated after finalization of VOCs quantity by the Expert agency. CPCB will engage the Expert agency and all the units are requested to extend necessary support to the Expert agency for satisfactory completion of the task in time.
6. Representative of MPCB communicated their views telephonically and requested CPCB for guidance in the matter of development of standards for chemical storage as per the direction of para 57(g) of Hon'ble NGT order

dated 18.12.2015. It is informed that MPCB has issued directions on 01.08.2019 to respondents for necessary actions with respect to order passed by Hon'ble NGT in the matter on 15.07.2019.

7. It was decided that the CPCB has already developed standards for Oil refinery and Petrochemical units, which were notified vide GSR dated 18.03.2008 and 09.11.2012, respectively. MPCB may adopt the norms or make further stringent norms for Mahul area, as location specific standard.

Meeting ended with tanks to the chair.

CENTRAL POLLUTION CONTROL BOARD,

IPC-I Division

Sub: Meeting with BPCL, HPCL, Sea lord containers, and Aegis and MPCB on August 14, 2019 at 11 AM, 5 th Floor, CPCB

S. No.	Name	Organization	Contact details (Mobile & E-mail)	Signature
1.	Subhash Nandanwar	HPCL - MR	9930997246	
2.	A. B. Chattopadhyay	HPCL - MR	9619613291	
3.	S. A. Dhakshina Murthy	HPCL, HQO, Mumbai	9811807631	
4.	Nilesh Kandalkar	BPCL - MR	9594015384	
5.	Rajiv Chakree	—"—	8452012475	
6.	K. L. Sawant	Aegis Logistics Ltd	8879085295	
7.	Rajiv Chohan	Aegis Group	9930306152	
8.	Gurnam Singh.	CPCB	7840015561	
9.	Prasoon Gargava	CPCB, RO, Vadodara	9429896489	

S. No.	Name	Organization	Contact details (Mobile & E-mail)	Signature
10.	ABHIJIT PATHAK	CPCB, Air lab	9971566700 apathak.cpcb@nic.in	
11.	Adv. Siddharth A. Mehta	On behalf of the Applicants in E.A.No.05/2018 (THC)	9673396688 adv.siddharthmehta@gmail.com	
12.				
13.				

Annexure 2.

List of Data Requested by NEERI.

1	Questionnaire related to tank and other facilities, emission monitoring, vapour emission control system etc. (thru CPCB)
2	Thruput data of Products handled
3	Online VOC monitoring station data, wind data
4	Data sheet for various tank parameters for calculating tank VOC emissions as per AP-42
5	Details of tanker loading gantry and variables as per AP-42 for calculating VOC emissions
6	ETP details and data sheet considering tanks as Fixed roof tanks for VOC emission calculations as per AP-42

Annexure 3.

List of Data Files proved to NEERI and ICT.

1	Questionnaire related to tank and other facilities, emission monitoring, vapour emission control system etc. duly filled in
2	Thruput data of Products handled
3	Online VOC monitoring station data, wind data sheet
4	Data sheet for various tank parameters duly filled in for calculating tank VOC emissions as per AP-42
5	Details of tanker loading gantry and variables as per AP-42 data sheet duly filled in for calculating VOC emissions
6	ETP details and data sheet duly filled in considering tanks as Fixed roof tanks for VOC emission calculations as per AP-42

Annexure 4.

Detailed Calculations of Emissions.

1. Emissions from Tanks
2. Emissions from ETP
3. Emissions from Product Gantry

AEGIS LOGISTICS LIMITED - TANK EMISSION

Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Diameter	Tank Height	Tank Height	Liquid Height	Tank Capacity	Turnover per year	Throughput	Product withdrawal shell clingage factor	density of product	density of product	Zero Wind speed rim seal loss factor	Wind speed dependent rim seal loss factor	Average ambient wind speed	Seal wind speed exponent	True Vapor Pressure	True Vapor Pressure	Atmospheric pressure	Vapor Pressure function	Molecular weight of vapor	Vapor space volume	stock vapor density	Vapor space expansion factor	vented vapor saturatin factor	Total Deck fitting loss factor	Turn over factor	Working loss product factor	Liquid surface temp	Product Factor	Standing loss	Working loss	Emission Reduction Efficiency Vapour Control System	Total loss	Total loss
			(m)	(ft)	(m)	(ft)	(ft)		/yr	bbl/yr	bbl/1000ft2	Kg/m3	lb/gal	(lbmole/ft-yr)	(lbmole/(mph)^n-ft-yr)	mph	-	mmHg	psia	psia	-	lb/lbmole		lb/ft3			lb-mole/yr			celsius	-	*Note 1	*Note2		LT	LT
				D		H	H'	KL	N	Q	C	Rho	WL	KRa	KRb	v	n	PVA	PVA	PA	P*	Mv	VV	Wv	KE	KS	FF	KN	kp		Kc	Ls	Lw	%	lb/yr	kg/day
MEK	VFR TANK			41.01		32.97	29.4	1250	2.13	16778.9893	NA	784	6.54	NA	NA	4.8	NA	89.92	1.738	14.7	0.0314	72.1	5288.88	0.02176085	0.167	0.66	NA	1	1	25	NA	4630.127	2102.758	95	336.64	0.42
VAM	VFR TANK								3.56	27995.7757	NA	917.1	7.65	NA	NA	4.8	NA	114.611	2.215	14.7	0.0408	86.09	5288.88	0.03311794	0.081	0.82	NA	1	1	25	NA	4246.379	5339.534	95	479.30	0.59
STYRENE MONOMER	VFR TANK			68.90		49.22	46.92	5000	15.73	494601.763	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	11239.46	0.00232584	0.016	0.98	NA	1	1	25	NA	149.611	6624.944	95	338.73	0.42
STYRENE MONOMER	VFR TANK			68.9		49.22	47.41	5000	11.79	370824.867	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	9404.45	0.00232584	0.016	0.98	NA	1	1	25	NA	125.1847	4967.014	95	254.61	0.32
ACETONE	VFR TANK			68.9		49.22	46.52	5000	4.92	154784.458	NA	778.25	6.49	NA	NA	4.8	NA	229.698	4.440	14.7	0.0897	58.08	12707.47	0.04477836	0.362	0.51	NA	1	1	25	NA	38344.13	39915.63	95	3912.99	4.86
MEG	VFR TANK								0.26	8275.62728	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	12707.47	1.25E-05	0.041	1	NA	1	1	25	NA	2.377131	0.595752	95	0.15	0.00
STYRENE MONOMER	VFR TANK			68.9		49.22	47.08	5000	14.84	466834.827	NA	896.6	7.48	NA	NA	4.8	NA	6.59	0.127	14.7	0.0022	105.15	10627.79	0.00232584	0.016	0.98	NA	1	1	25	NA	141.4689	6253.02	95	319.72	0.40
HSD BS 4	VFR TANK			85.31		65.62	61.52	10000	11.04	694370.325	NA	818.75	6.83	NA	NA	4.8	NA	10	0.193	14.7	0.0033	90	28519.24	0.00302083	0.07	0.93	NA	1	1	25	NA	2047.098	12079.96	95	706.35	0.88
MS BSIV	VFR TANK								0.80	50193.4039	NA	707.66	5.90	NA	NA	4.8	NA	245.9	4.753	14.7	0.0973	68	28519.24	0.05612441	0.209	0.44	NA	1	1	25	NA	53725.63	16223.55	95	3497.46	4.34
ETHYL ALCOHOL DEN.	VFR TANK			85.31		65.62	60.66	10000	3.18	200255.954	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	33432.36	0.00913256	0.137	0.68	NA	1	1	25	NA	10382.02	10532.35	95	1045.72	1.30
HSD BS 4	VFR TANK								1.00	62699.4015	NA	818.75	6.83	NA	NA	4.8	NA	10	0.193	14.7	0.0033	90	7092.13	0.00302083	0.07	0.92	NA	1	1	25	NA	503.596	1090.781	95	79.72	0.10
METHANOL	VFR TANK								2.69	169432.331	NA	780.7	6.51	NA	NA	4.8	NA	127.039	2.456	14.7	0.0457	32.04	7092.13	0.01366199	0.226	0.54	NA	1	1	25	NA	4316.042	13330.85	95	882.34	1.10
BASE OIL	VFR TANK			46.59		65.62	61.95	3000	6.62	124972.066	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	7092.13	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
ETHYL ACETATE	VFR TANK			19.03		82.03	74.38	640	0.94	3803.46864	NA	887.5	7.40	NA	NA	4.8	NA	94.3087	1.823	14.7	0.0331	88.1	2230.69	0.02788766	0.158	0.51	NA	1	1	25	NA	1829.664	610.8567	95	122.03	0.15
ISONONANOL	VFR TANK								0.70	2809.77623	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2230.69	0.00022273	0.043	0.99	NA	1	1	25	NA	7.720009	3.604137	95	0.57	0.00
BASE OIL	VFR TANK			22.64		82.03	79.07	900	7.62	43160.7694	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			22.64		82.03	79.07	900	5.90	33417.9731	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								0.92	5229.8124	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1283.57	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			22.97		82.03	80.38	930	2.87	16778.7062	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	778.75	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
ISONONANOL	VFR TANK			19.69		82.03	80.38	685	3.86	16634.8586	NA	826.7	6.895	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	561.74	0.00022273	0.043	1	NA	1	1	25	NA	1.963716	21.33775	95	1.17	0.00
PROPYLHEPTANOL	VFR TANK								3.27	14082.589	NA	811	6.76	NA	NA	4.8	NA	0.04	0.001	14.7	0.0000	158.3	561.74	2.1253E-05	0.043	1	NA	1	1	25	NA	0.187379	1.723675	95	0.10	0.00
ACETIC ACID	VFR TANK			36.09		82.025	79.15	2300	12.10	175029.446	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	3321.6	0.00309994	0.072	0.94	NA	1	1	25	NA	254.3632	3124.729	95	168.95	0.21
ISONONANOL	VFR TANK								1.06	15310.6301	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	3321.6	0.00022273	0.043	1	NA	1	1	25	NA	11.61156	19.63915	95	1.56	0.00
MEG	VFR TANK								0.93	13432.9787	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	3321.6	1.25E-05	0.041	1	NA	1	1	25	NA	0.621357	0.967024	95	0.08	0.00
ACETIC ACID	VFR TANK			26.25		82.025	78.42	1200	5.11	38537.0788	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2100.86	0.00309994	0.072	0.92	NA	1	1	25	NA	157.4577	687.9866	95	42.27	0.05
ACETIC ANHYDRIDE	VFR TANK								0.80	5841.53853	NA	1050	8.76	NA	NA	4.8	NA	5.253	0.102	14.7	0.0017	102.09	2100.86	0.00180001	0.06	0.98	NA	1	1	25	NA	81.16004	60.55496	95	7.09	0.01
ALPHAOLEFINC-14	VFR TANK								1.33	10023.9666	NA	910	7.59	NA	NA	4.8	NA	0.16	0.003	14.7	0.0001	196	2100.86	0.00010526	0.041	1	NA	1	1	25	NA	3.309285	6.076416	95	0.47	0.00
ETHYL ALCOHOL DEN.	VFR TANK								0.73	5508.25821	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2100.86	0.00913256	0.137	0.76	NA	1	1	25	NA	729.1495	289.7038	95	50.94	0.06
MEG	VFR TANK								2.24	16872.5656	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	2100.86	1.25E-05	0.041	1	NA	1	1	25	NA	0.392999	1.214636	95	0.08	0.00
ACETIC ACID	VFR TANK			27.89		82.025	75.23	1375	5.08	43923.6105	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	4326.21	0.00309994	0.072	0.87	NA	1	1	25	NA	306.6238	784.1502	95	54.54	0.07
ETHYL ACETATE	VFR TANK								2.07	17890.4945	NA	887.5	7.40	NA	NA	4.8	NA	94.3087	1.823	14.7	0.0331	88.1	4326.21	0.02788766	0.158	0.54	NA	1	1	25	NA	3757.191	2873.306	95	331.52	0.41
ETHYL ALCOHOL DEN.	VFR TANK								0.93	8010.22498	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4326.21	0.00913256	0.137	0.64	NA	1	1	25	NA	1264.426	421.2934	95	84.29	0.10
MEG	VFR TANK								0.80	6925.17708	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4326.21	1.25E-05	0.041	1	NA	1	1	25	NA	0.809285	0.498535	95	0.07	0.00
DIMETHYL FORMAMIDE	VFR TANK			32.81		82.025	79.3	1900	2.34	27941.376	NA	937.9	7.82	NA	NA	4.8	NA	3.995	0.077	14.7	0.0013	73.05	2591.4	0.00097954	0.044	0.98	NA	1	1	25	NA	39.95098	157.6219	95	9.88	0.01
ACETIC ACID	VFR TANK			32.81		82.025	79.4	1900	9.85	117722.142	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2508.18	0.00309994	0.072	0.94	NA	1	1	25	NA	192.0727	2101.645	95	114.69	0.14
ISONONANOL	VFR TANK								0.36	4278.0683	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2508.18	0.00022273	0.043	1	NA	1	1	25	NA	8.768031	5.487535	95	0.71	0.00
MEG	VFR TANK								2.58	30795.587	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	2508.18	1.25E-05	0.041	1	NA	1	1	25	NA	0.469194	2.216937	95	0.13	0.00
BASE OIL	VFR TANK			49.22		82.025	80.06	4300	1.08	29217.6741	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								0.55	14755.9485	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								2.22	59993.6949	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								0.68	18330.3514	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								1.07	28857.9567	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK								0.56	15068.3937	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	4720.17	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	1.31	18911.74	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			32.81		82.025	80.06	1900	3.74	44701.1906	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	1953.37	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
ALPHAOLEFINC-14	VFR TANK			49.22		82.025	80.06	4300	0.46	12490.934	NA	910	7.59	NA	NA	4.8	NA	0.16	0.003	14.7	0.0001	196	4720.17	0.00010526	0.041	1	NA	1	1	25	NA	7.435236	7.571864	95	0.75	0.00
ETHYL ALCOHOL DEN.	VFR TANK								2.53	68559.8964	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4720.17	0.00913256	0.137	0.84	NA	1	1	25	NA	1810.685	3605.87	95	270.83	0.34
LAB	VFR TANK								0.28	7592.80797	NA	847.35	7.07	NA	NA	4.8	NA	0.01	0.000	14.7	0.0000	326.49	4720.17	1.0959E-05	0.041	1	NA	1	1	25	NA	0.774085	0.479186	95	0.06	0.00
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	5.41	78333.6946	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
ISONONANOL	VFR TANK			36.09		82.025	80.06	2300	8.59	124242.556	NA	826.7	6.89	NA	NA	4.8	NA	0.46	0.009	14.7	0.0002	144.258	2398.54	0.00108079	0.043	1	NA	1	1	25	NA	40.68633	159.3676	95	10.00	0.01
BASE OIL	VFR TANK			36.09		82.025	80.06	2300	1.64	23777.504	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2398.54	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
BASE OIL	VFR TANK			33.63		82.025	80.06	2000	2.78	34956.9327	NA	800-870	6.67-7.25	NA	NA	4.8	NA	0	0.000	14.7	0.0000	700	2059.85	0	0.04	1	NA	1	1	25	NA	0	0	-	0.00	0.00
MEG	VFR TANK			49.22		82.025	80.06	4300	10.28	278142.765	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	20.02316	95	1.05	0.00
ETHYL ALCOHOL DEN.	VFR TANK			49.22		82.025	80.06	4300	1.63	44039.4846	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	4720.17	0.00913256	0.137	0.84	NA	1	1	25	NA	1810.685	2316.233	95	206.35	0.26
MEG	VFR TANK								6.30	170272.396	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	12.2577	95	0.66	0.00
ACETIC ACID	VFR TANK			36.09		82.025	80.06	2300	14.00	202488.469	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2398.54	0.00309994	0.072	0.95	NA	1	1	25	NA	185.6306	3614.943	95	190.03	0.24
ETHYL ALCOHOL DEN.	VFR TANK								1.01	14609.1731	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2398.54	0.00913256	0.137	0.84	NA	1	1	25	NA	920.0938	768.3615	95	84.42	0.10
MEG	VFR TANK			49.22		82.025	80.06	4300	9.95	269225.807	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	19.38124	95	1.01	0.00
ACETIC ACID	VFR TANK			39.37		82.025	80.38	2800	15.31	269710.398	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2496.62	0.00309994	0.072	0.96	NA	1	1	25	NA	195.2553	4815.029	95	250.51	0.31
ETHYL ALCOHOL DEN.	VFR TANK								0.95	16809.8078	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2496.62	0.00913256	0.137	0.86	NA	1	1	25	NA	980.5207	884.1027	95	93.23	0.12
ACETIC ACID	VFR TANK			41.01		82.025	80.22	3000	16.27	306944.808	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2948.3	0.00309994	0.072	0.96	NA	1	1	25	NA	230.5802	5479.759	95	285.52	0.35
ETHYL ALCOHOL DEN.	VFR TANK								0.79	14864.3478	NA	772	6.44	NA	NA	4.8	NA	59.098	1.142	14.7	0.0202	46.04	2948.3	0.00913256	0.137	0.86	NA	1	1	25	NA	1157.913	781.7823	95	96.98	0.12
ACETIC ACID	VFR TANK			49.22		82.025	80.06	4300	16.90	457033.683	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	4720.17	0.00309994	0.072	0.95	NA	1	1	25	NA	365.3089	8159.234	95	426.23	0.53
MEG	VFR TANK			49.22		82.025	80.06	4300	8.76	237002.322	NA	1105.15	9.22	NA	NA	4.8	NA	0.06	0.001	14.7	0.0000	62.07	4720.17	1.25E-05	0.041	1	NA	1	1	25	NA	0.882982	17.06151	95	0.90	0.00
ACETIC ACID	VFR TANK			36.09		82.025	80.06	2300	15.30	221351.66	NA	1038.4	8.66	NA	NA	4.8	NA	15.38	0.297	14.7	0.0051	60.05	2398.54	0.00309994	0.072	0.95	NA	1	1	25	NA	185.6306	3951.7	95	206.87	0.26
																																			14970.3	18.58

Note: The Fixed Roof Storage tank Emission Calculation are based on AP- 42 Chapter 7 with 95% Emission reduction efficiency for Carbon Adsorption vapour control system provided by the company. (after PV Valve)

Note 1: Standing loss=365* Vv*Wv*Ke*Ks

Note 2: Working loss=0.001*Mv*Q*Pv*Kn*Kp

Above method is verified by ICT,Mumbai,Chemical Engg. Dept.

Note 3: Out of All above products, Hazardous Air Pollutants (HAP's) as per US EPA are only following--

Product	Tank Emission (kg/day)	EPA classification as Carcinogenic from inhalation
Styrene Monomer	1.14	No
Methanol	1.1	No
VAM	0.59	No
Dimethyl Formamide	0.01	No
TOTAL	2.84	

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AEGIS LOGISTICES LTD - ETP VOC EMISSION ESTIMATION DATA

Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Height	Liquid Height	Tank Capacity	Throughput of ETP Water	density of product	True Vapor Pressure(1)	Molecular weight of vapor	Turn over factor	Working loss product factor	Vented Vapour Space saturation factor	Vapour space Expansion factor	Liquid surface temp.	Vapor space outage	Vapor space volume	stock vapor density	Standing loss	Working loss	Total loss	Total loss
			(ft)	(ft)	(ft)		bbl/yr	Kg/m3	psia	lb/lbmole					Degree Celcius	ft	ft3	lb/ft3			LT	LT
			D	H	H'	KL	Q	Rho	PVA	Mv	KN	KP	KS	KE		HVO	Vv	Wv	Ls	Lw	Lb/yrs	KG/day
Collection Tank	VFR TANK		18.4	13.1	6.6	100	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	7	1800.528	0.0001413	3.750689	20.55174	24.30242925	0.030162
Primary Settling Tank	VFR TANK		5.9	9.8	4.9	8.2	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	5	136.292	0.0001413	0.28391	20.55174	20.83565011	0.025859
Equalisation Tank 1	VFR TANK		8.5	9.8	4.9	15.6	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	5	285.906	0.0001413	0.595573	20.55174	21.14731312	0.026246
Equalisation Tank 2	VFR TANK		6.6	9.8	4.9	8.4	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	5	168.490	0.0001413	0.350982	20.55174	20.90272222	0.025942
Buffer Tank	VFR TANK		3.9	6.6	3.3	4.08	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	3	40.383	0.0001413	0.084121	20.55174	20.63586194	0.025611
Sludge Tank	VFR TANK		5.6	6.6	3.3	5.78	25253.547	1000	0.02540	32.04	1	1	1.000	0.040	25	3	81.459	0.0001413	0.169687	20.55174	20.72142732	0.025717
																						0.159537

Note:

1. True vapor pressure - VAPOR PRESSURE OF METHANOL AT 25 DEG C * MOLE FRACTION OF METHANOL IN PRIMARY FEED TANK WATER 2.45*0.0104=0.0254

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2. Basis for above Calculations:

ETP Water contains Water soluable products:

i) High volatile product viz Methanol, Ethanol , Acetone, Iso propyl alcohol & Acetic Acid.

ii) Low volatile products- MEG, Caustic Soda Lye

iii) For calculation purpose total high volatile products content in ETP waste Water is considered.Further, Properties of Methanol is considered for calculating total VOC emission from ETP.We expect actual emission were less as Methanol is high volatile product.

3. ETP operated at 11 KL/day capacity

4. All Above Tanks are covered.Collection tank vent is provided with Activated carbon adsorber.

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AEGIS - TANKER GANTRY VOC LOADING LOSS

Tank No	Service	Type of Tank	TYPE OF SEAL	Tank Diameter	Tank Height	Liquid Height	Tank Capacity	Throughput	Throughput	True Vapor Pressure	Molecular weight of vapor	Saturation Factor	Temperature	*Emission Reduction Efficiency of vapour Control System	*Loading loss	*Loading loss	*Loading Loss
				(ft)	(ft)	(ft)		bbl/yr	gallon /yr	psia	lb/lbmole	-	R		LB/1000 gallon	LB/yrs	Kg/day
				D	H	H'	KL	Q	Q	PVA	Mv	S		%			
T113	MIX-XYLENE	Internal Floating Roof tank with Cone Roof with double wiper seals (IFR+CONE ROOF TANK)*		41.01	28.54	23.32	1000	19012.4627	798523.433	0.226	106.17	0.5	536.67	99	0.002787965	2.2262557	0.002763
	ORTHO-XYLENE							6457.7713	271226.395	0.127	106.168	0.5	536.67	99	0.001570772	0.4260347	0.00052875
	VAM							3597.35273	151088.815	2.215	86.09	0.5	536.67	99	0.022140712	3.345214	0.00415173
T114	CYCLOHEXANONE	IFR+CONE ROOF TANK*		41.01	34.45	29.86		6546.78076	274964.792	1.837	98.15	0.5	536.67	99	0.020930528	5.7551583	0.0071427
	NBUTANOL						1250	8479.08955	356121.761	0.119	74.12	0.5	536.67	99	0.001026013	0.3653857	0.00045348
	ORTHO-XYLENE							25203.1097	1058530.61	0.127	106.168	0.5	536.67	99	0.001570772	1.6627099	0.00206358
T115	MEK	VFR TANK		41.01	#	29.4	1250	16778.9893	704717.552	1.738	72.1	0.5	536.67	99	0.014548029	10.252251	0.01272403
	VAM							27995.7757	1175822.58	2.215	86.09	0.5	536.67	99	0.022140712	26.03355	0.03231013
T116	ACETONE	IFR+CONE ROOF TANK*		41.73	#	29.4	1350	7894.07279	331551.057	4.440	58.08	0.5	536.67	99	0.029936182	9.9253726	0.01231834
	TOLUENE							7503.7123	315155.917	0.548	92.13	0.5	536.67	99	0.005862524	1.8476092	0.00229306
	VAM							6830.08772	286863.684	2.215	86.09	0.5	536.67	99	0.022140712	6.3513663	0.00788265
T117	BUTYL ACETATE	IFR+CONE ROOF TANK*		41.73	#	30.25	1340	14403.3348	604940.061	0.243	116.16	0.5	536.67	99	0.003276752	1.9822387	0.00246015
	MIX-XYLENE							54511.6245	2289488.23	0.226	106.17	0.5	536.67	99	0.002787965	6.3830139	0.00792193
	ORTHO-XYLENE							9809.1973	411986.287	0.127	106.168	0.5	536.67	99	0.001570772	0.6471364	0.00080316
	TOLUENE							7657.09321	321597.915	0.548	92.13	0.5	536.67	99	0.005862524	1.8853756	0.00233993
T118	BUTYL ACETATE	IFR+CONE ROOF TANK*		41.73	#	30.38	1330	69620.5648	2924063.72	0.243	116.16	0.5	536.67	99	0.003276752	9.5814324	0.01189148
T119	ACETONE	IFR+CONE ROOF TANK*		68.9	#	43.27	5000	223703.572	9395550.04	4.440	58.08	0.5	536.67	99	0.029936182	281.26689	0.34907918
	BASE OIL							28501.7935	1197075.33	0	700	0.5	536.67	0	0	0	0
	METHANOL							28564.6751	1199716.36	2.456	32.04	0.5	536.67	99	0.009133604	10.957734	0.0135996
T120	STYRENE MONOMER	VFR TANK		68.90	#	46.92	5000	494601.763	20773274	0.127	105.15	0.5	536.67	99	0.001554917	32.300722	0.04008829
T121	ACETONE	IFR+CONE ROOF TANK*		68.9	#	43.96	5000	79482.6246	3338270.23	4.440	58.08	0.5	536.67	99	0.029936182	99.935064	0.124029
	ETHYL ALCOHOL DEN.							31506.3954	1323268.61	1.142	46.04	0.5	536.67	99	0.006105492	8.0792062	0.01002707
	METHANOL							83083.8833	3489523.1	2.456	32.04	0.5	536.67	99	0.009133604	31.87192	0.03955611
	MS BSIV							19112.6535	802731.445	4.753	68	0.5	536.67	99	0.037521485	30.119676	0.03738141
T122	ETHYL ALCOHOL DEN.	IFR+CONE ROOF TANK*		68.9	49.22	45.93	5000	16810.1372	706025.76	1.142	46.04	0.5	536.67	99	0.006105492	4.3106348	0.00534991
	MS BSIV							246723.104	10362370.4	4.753	68	0.5	536.67	99	0.037521485	388.81153	0.48255239
T123	STYRENE MONOMER	VFR TANK		68.9	#	47.41	5000	370824.867	15574644.4	0.127	105.15	0.5	536.67	99	0.001554917	24.217283	0.03005597
T124	ACETONE	VFR TANK		68.9	#	46.52	5000	154784.458	6500947.22	4.440	58.08	0.5	536.67	99	0.029936182	194.61354	0.24153406
	MEG							8275.62728	347576.346	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0029047	3.605E-06
T125	ISO PROPYL ALCOHOL	IFR+CONE ROOF TANK*		68.9	#	45.24	5000	55551.3726	2333157.65	0.803	60.09	0.5	536.67	99	0.005597937	13.060869	0.01620979
	METHANOL							132294.781	5556380.78	2.456	32.04	0.5	536.67	99	0.009133604	50.749779	0.06298534
	MIX-XYLENE							18319.9319	769437.139	0.226	106.17	0.5	536.67	99	0.002787965	2.1451641	0.00266235
T126	STYRENE MONOMER	VFR TANK		68.9	#	47.08	5000	466834.827	19607062.8	0.127	105.15	0.5	536.67	99	0.001554917	30.48736	0.03783774
T127	HSD BS 4	IFR+CONE ROOF TANK*		85.31	#	59.38	10000	516130.218	21677469.2	0.193	90	0.5	536.67	99	0.002019552	43.778781	0.05433367
T128	MS BSIV	IFR+CONE ROOF TANK*		85.31	#	59.19	10000	568707.446	23885712.7	4.753	68	0.5	536.67	99	0.037521485	896.22742	1.11230417
T129	HSD BS 4	VFR TANK		85.31	#	61.52	10000	694370.325	29163553.7	0.193	90	0.5	536.67	99	0.002019552	58.89732	0.07309722
	MS BSIV							50193.4039	2108122.97	4.753	68	0.5	536.67	99	0.037521485	79.099905	0.09817057
T130	ACETONE	Internal Floating Roof tank with Dome Roof with double wiper seals (IFR+DOME ROOF TANK)		85.31	#	60.6	10000	38113.82	1600780.44	4.440	58.08	0.5	536.67	99	0.029936182	47.921254	0.05947487
	ETHYL ALCOHOL DEN.							54739.3502	2299052.71	1.142	46.04	0.5	536.67	99	0.006105492	14.036848	0.01742107
	METHANOL							695483.98	29210327.2	2.456	32.04	0.5	536.67	99	0.009133604	266.79555	0.33111886
T131	ETHYL ALCOHOL DEN.	IFR+DOME ROOF TANK		85.31	#	60.63	10000	118030.764	4957292.09	1.142	46.04	0.5	536.67	99	0.006105492	30.266708	0.03756389
	TOLUENE							551801.458	23175661.2	0.548	92.13	0.5	536.67	99	0.005862524	135.86788	0.16862506
T132	ETHYL ALCOHOL DEN.	IFR+DOME ROOF TANK		85.31	#	60.65	10000	154078.419	6471293.6	1.142	46.04	0.5	536.67	99	0.006105492	39.510433	0.04903624
	METHANOL							126792.072	5325267.01	2.456	32.04	0.5	536.67	99	0.009133604	48.638878	0.06036551
	MIX-XYLENE							31453.115	1321030.83	0.226	106.17	0.5	536.67	99	0.002785422	3.6796282	0.00456677
	TOLUENE							222361.069	9339164.9	0.548	92.13	0.5	536.67	99	0.005862524	54.751081	0.06795134
T133	ETHYL ALCOHOL DEN.	VFR TANK		85.31	#	60.66	10000	200255.954	8410750.06	1.142	46.04	0.5	536.67	99	0.006105492	51.351769	0.06373247
	HSD BS 4							62699.4015	2633374.86	0.193	90	0.5	536.67	99	0.002019552	5.3182381	0.00660044
	METHANOL							169432.331	7116157.92	2.456	32.04	0.5	536.67	99	0.009133604	64.996165	0.08066647
T134	BASE OIL	VFR TANK		46.59	#	61.95	3000	124972.066	5248826.79	0.000	700	0.5	536.67	0	0	0	0
T135	ETHYL ACETATE	IFR+DOME ROOF TANK		46.59	#	62.08	3000	55504.9514	2331207.96	1.823	88.1	0.5	536.67	99	0.01864405	43.463157	0.05394195
	ORTHO-XYLENE							20541.1347	862727.656	0.126	106.168	0.5	536.67	99	0.001552905	1.3397342	0.00166274
T136	METHANOL	IFR+DOME ROOF TANK		46.59	#	61.96	3000	16034.6475	673455.194	2.456	32.04	0.5	536.67	99	0.009133604	6.1510727	0.00763407
	ORTHO-XYLENE							17431.4723	732121.837	0.126	106.168	0.5	536.67	99	0.001552905	1.1369157	0.00141102
T137	ACETONE	IFR+DOME ROOF TANK		46.59	#	62.08	3000	81884.516	3439149.67	4.440	58.08	0.5	536.67	99	0.029936182	102.95501	0.12777704
	ETHYL ALCOHOL DEN.							17080.5423	717382.778	1.142	46.04	0.5	536.67	99	0.006105492	4.379975	0.00543597
	ISO PROPYL ALCOHOL							89999.4306	3779976.08	0.803	60.09	0.5	536.67	99	0.005597937	21.160066	0.02626167
	METHANOL							13229.4466	555636.759	2.456	32.04	0.5	536.67	99	0.009133604	5.0749659	0.00629852
T138	ETHYL ACETATE	VFR TANK		19.03	#	74.38	640	3803.46864	159745.683	1.823	88.1	0.5	536.67	99	0.01864405	2.9783064	0.00369636
	ISONONANOL							2809.77623	118010.602	0.009	144.258	0.5	536.67	99	0.000148905	0.0175724	2.1809E-05
T139	BASE OIL	VFR TANK		22.64	#	79.07	900	43160.7694	1812752.32	0.000	700	0.5	536.67	0	0	0	0
T140	BASE OIL	VFR TANK		22.64	#	79.07	900	33417.9731	1403554.87	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							5229.8124	219652.121	0.000	700	0.5	536.67	0	0	0	0
T141	BASE OIL	VFR TANK		22.97	#	80.38	930	16778.7062	704705.661	0.000	700	0.5	536.67	0	0	0	0
T142	ISONONANOL	VFR TANK		19.69	#	80.38	685	16634.8586	698664.06	0.009	144.258	0.5	536.67	99	0.000148905	0.1040348	0.00012912
	PROPYLHEPTANOL							14082.589	591468.738	0.001	158.3	0.5	536.67	99	1.42087E-05	0.008404	1.043E-05
T143	ACETIC ACID	VFR TANK		36.09	82.03	79.15	2300	175029.446	7351236.73	0.297	60.05	0.5	536.67	99	0.00207244	15.234996	0.01890809
	ISONONANOL							15310.6301	643046.464	0.009	144.258	0.5	536.67	99	0.000148905	0.0957531	0.00011884
	MEG							13432.9787	564185.106	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0047148	5.8516E-06
T144	ACETIC ACID	VFR TANK		26.25	82.03	78.42	1200	38537.0788	1618557.31	0.297	60.05	0.5	536.67	99	0.00207244	3.3543626	0.00416309
	ACETIC ANHYDRIDE							5841.53853	245344.618	0.102	102.09	0.5	536.67	99	0.001203381	0.2952431	0.00036642
	ALPHAOLEFINC-14							10023.9666	421006.599	0.003	196	0.5	536.67	99	7.03702E-05	0.0296263	3.6769E-05
	ETHYL ALCOHOL DEN.							5508.25821	231346.845	1.142	46.04	0.5	536.67	99	0.006105492	1.4124864	0.00175303
	MEG							16872.5656	708647.757	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0059221	7.3499E-06
T145	ACETIC ACID	VFR TANK		27.89	82.03	75.23	1375	43923.6105	1844791.64	0.297	60.05	0.5	536.67	99	0.00207244	3.8232197	0.00474498
	ETHYL ACETATE							17890.4945	751400.769	1.823	88.1	0.5	536.67	99	0.01864405	14.009153	0.0173867
	ETHYL ALCOHOL DEN.							8010.22498	336429.449	1.142	46.04	0.5	536.67	99	0.006105492	2.0540674	0.00254929
	MEG							6925.17708	290857.437	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0024307	3.0167E-06
T146	DIMETHYL FORMAMIDE	VFR TANK		32.81	82.03	79.3	1900	27941.376	1173537.79	0.077	73.05	0.5	536.67	99	0.000654862	0.7685049	0.00095379
T147	ACETIC ACID	VFR TANK		32.81	82.03	79.4	1900	117722.142	4944329.95	0.297	60.05	0.5	536.67	99	0.00207244	10.246826	0.01271729
	ISONONANOL							4278.0683	179678.869	0.009	144.258	0.5	536.67	99	0.000148905	0.0267551	3.3206E-05
	MEG							30795.587	1293414.65	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0108089	1.3415E-05
T150	BASE OIL	VFR TANK		49.22	82.03	80.06	4300	29217.6741	1227142.31	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							14755.9485	619749.836	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							59993.6949	2519735.18	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							18330.3514	769874.759	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							28857.9567	1212034.18	0.000	700	0.5	536.67	0	0	0	0
	BASE OIL							15068.3937	632872.536	0.000	700	0.5	536.67	0	0	0	0
T151	BASE OIL	VFR TANK		36.09	82.03	80.06	2300	18911.74	794293.081	0.000	700	0.5	536.67	0	0	0	0
T152	BASE OIL	VFR TANK		32.81	82.03	80.06	1900	44701.1906	1877450.01	0.000	700	0.5	536.67	0	0	0	0
T153	ALPHAOLEFINC-14	VFR TANK		49.22	82.03	80.06	4300	12490.934	524619.227	0.003	196	0.5	536.67	99	7.03702E-05	0.0369175	4.5818E-05
	ETHYL ALCOHOL DEN.							68559.8964	2879515.65	1.142	46.04	0.5	536.67	99	0.006105492	17.58086	0.02181953
	LAB							7592.80797	318897.935	0.000	326.49	0.5	536.67	99	7.32626E-06	0.0023363	2.8996E-06
T154	BASE OIL	VFR TANK		36.09	82.03	80.06	2300	78333.6946	3290015.17	0.000	700	0.5	536.67	0	0	0	0
T155	ISONONANOL	VFR TANK		36.09	82.03	80.06	2300	124242.556	5218187.33	0.009	144.258	0.5	536.67	99	0.000148905	0.777016	0.00096435
T156	BASE OIL	VFR TANK		36.09	82.03	80.06	2300	23777.504	998655.168	0.000	700	0.5	536.67	0	0	0	0
T157	BASE OIL	VFR TANK		33.63	82.03	80.06	2000	34956.9327	1468191.17	0.000	700	0.5	536.67	0	0	0	0
T158	MEG	VFR TANK		49.22	82.03	80.06	4300	278142.765	11681996.1	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0976254	0.00012116
T159	ETHYL ALCOHOL DEN.	VFR TANK		49.22	82.03	80.06	4300	44039.4846	1849658.36	1.142	46.04	0.5	536.67	99	0.006105492	11.293075	0.01401579
	MEG							170272.396	7151440.62	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0597639	7.4173E-05
T160	ACETIC ACID	VFR TANK		36.09	82.03	80.06	2300	202488.469	8504515.7	0.297	60.05	0.5	536.67	99	0.00207244	17.625097	0.02187444
	ETHYL ALCOHOL DEN.							14609.1731	613585.269	1.142	46.04	0.5	536.67	99	0.006105492	3.7462401	0.00464944
T161	MEG	VFR TANK		49.22	82.03	80.06	4300	269225.807	11307483.9	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0944956	0.00011728
T162	ACETIC ACID	VFR TANK		39.37	82.03	80.38	2800	269710.398	11327836.7	0.297	60.05	0.5	536.67	99	0.00207244	23.47626	0.02913629
	ETHYL ALCOHOL DEN.							16809.8078	706011.928	1.142	46.04	0.5	536.67	99	0.006105492	4.3105503	0.00534981
T163	ACETIC ACID	VFR TANK		41.01	82.03	80.22	3000	306944.808	12891681.9	0.297	60.05	0.5	536.67	99	0.00207244	26.717235	0.03315865
	ETHYL ALCOHOL DEN.							14864.3478	624302.606	1.142	46.04	0.5	536.67	99	0.006105492	3.8116747	0.00473065
T164	ACETIC ACID	VFR TANK		49.22	82.03	80.06	4300	457033.683	19195414.7	0.297	60.05	0.5	536.67	99	0.00207244	39.781342	0.04937246
T165	MEG	VFR TANK		49.22	82.03	80.06	4300	237002.322	9954097.52	0.001	62.07	0.5	536.67	99	8.35691E-06	0.0831855	0.00010324
T166	ACETIC ACID	VFR TANK		36.09	82.03	80.06	2300	221351.66	9296769.74	0.297	60.05	0.5	536.67	99	0.00207244	19.266996	0.02391219
																3541.643	4.395519

Note : ***The loading loss calculations are based on AP-42 Chapter 5 with 99% emission reduction efficiency for vapour control sysytem having brine condenser,activated charcoal adsorber and water scrubbing system provided by the Company at tanker filling bay.**

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Annexure 5.

Emission Estimates after control systems in Kg/Day.

Tanks	EPA	GSR 820(E)
Acetone	-	4.86
Motor Spirit	-	-
Ethanol	-	-
Acetic Acid	-	-
Styrene Monomer	1.14	1.14
Methanol	1.10	-
HSD	-	-
VAM	0.59	-
Dimethyl Formamide	0.01	-
Sub Total	**2.84**	**6.00**

Product Gantry	EPA	GSR 820(E)
Acetone	-	0.91
Methanol	0.60	-
Toluene	0.24	0.24
Styrene Monomer	0.11	0.11
VAM	0.04	-
Mix-Xylene	0.02	0.02
Ortho Xylene	0.00	0.00
Dimethyl Formamide	0.00	-
Sub total	**1.01**	**1.28**

ETP	EPA	GSR 820(E)
Effluent	**0.16**	**0.16**

Summary table of emissions after control systems

Source of Emission in Kg/Day	EPA	GSR 820(E)
Tanks	2.84	6.00
ETP	0.16	0.16
Product Gantry	1.01	1.28
Total	**4.01**	**7.44**

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Annexure 6.

Dispersion Modelling Calculations.

<u>**Appendix 2 - VOC concentration - Aegis TANK EMISSION**</u>

$$\bar{u}_1 = \bar{u}\left(\frac{z_1}{H}\right)^{\alpha} \quad \ldots (Eq.\ 1)$$

$\alpha = 0.5$ *for stable conditions*; $\alpha = 0.25$ *for unstable conditions*

$$\left.\begin{aligned} \sigma_y &= \text{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z &= \text{speading coefficient} = b \cdot x^{p} \end{aligned}\right\} \quad \ldots (Eq.\ 2)$$

$$(\rho)(x, y, z, H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\text{horizontal component}}\right] \cdot \underbrace{\left\{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]\right\}}_{\text{vertical component}} \quad \ldots (Eq.\ 3)$$

x = logitudinal straight distance from the source tank (m)
y = horizonal component from the source tank = 0
z = vertical component from the source tank = 0
H = tank height
Q = source strength of VOC (µg/s)
$\bar{u}$ = corrected velocity in x-direction (m/s)
ρ = VOC concentration (µg/m³)

Basis of calculations:

- The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
- Wind velocity data given by Aegis Terminal as per weather monitoring station provided at site.
- Strong solar radiation and unstable air conditions are assumed.
- Emission point height is taken from ground level considering foundation height and roof nozzle height in addition to tank height.

Tank Emission Summary [4]

Sr. No.	Product	Type of Tank	Tank Height (meters)	Emission Point on tank top (meters)	Total Emission (Kg/day)
1	Styrene Monomer	VFR	15	16	1.14
2	Methanol	VFR	20	21	1.10
3	VAM	VFR	10	11	0.59
4	Dimethyl Formamide	VFR	25	26	0.01
5	Acetone	VFR	15	16	4.86

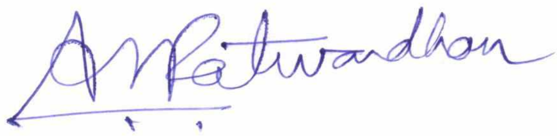
[4] The calculations details for the above mentioned products is given on the following pages.

Styrene Monomer (Aegis Tank)		
H (emission point)	16	m
Tank height	15	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	1.14	kg/day
Q	1.319E+04	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.44	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.08	µg/m^3 ... from Eq. (3)

Methanol (Aegis Tank)		
H (emission point)	21	m
Tank height	20	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	1.1	kg/day
Q	1.273E+04	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.35	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.07	μg/m^3 ... from Eq. (3)

VAM (Aegis Tank)		
H (emission point)	11	m
Tank height	10	m
z_1	10	*m, mandatory parameter in Eq. (1)*
Q	0.59	kg/day
Q	6.829E+03	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.58	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.04	μg/m^3 ... from Eq. (3)

Dimethyl Formamide (Aegis Tank)		
H (emission point)	26	m
Tank height	25	m
z_1	*10*	*m, mandatory parameter in Eq. (1)*
Q	0.01	kg/day
Q	1.157E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.28	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00	µg/m^3 ... from Eq. (3)



Acetone (Aegis Tank)		
H (emission point)	16	m
Tank height	15	m
z_1	10	m, mandatory parameter in Eq. (1)
Q	4.86	kg/day
Q	5.624E+04	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.44	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.32	μg/m^3 ... from Eq. (3)

Appendix 2 – Summary of calculation of VOC concentration (Aegis TANKER GANTRY)

$$\begin{cases} \bar{u}_1 = \bar{u}\left(\frac{z_1}{H}\right)^{\alpha} & \text{... (Eq. 1)} \\ \alpha = 0.5 \text{ for stable conditions; } \alpha = 0.25 \text{ for unstable conditions} \end{cases}$$

$$\left.\begin{cases} \sigma_y = \textit{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z = \textit{speading coefficient} = b \cdot x^{p} \end{cases}\right\} \text{... (Eq. 2)}$$

$$\langle\rho\rangle(x, y, z, H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\textit{horizontal component}}\right] \cdot \left\{\underbrace{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]}_{\textit{vertical component}}\right\} \text{... (Eq. 3)}$$

x = *logitudinal straight distance from the source tank* (m)

y = *horizonal component from the source tank* $= 0$

z = *vertical component from the source tank* $= 0$

H = *tank height*

Q = *source strength of VOC* $(\mu g/s)$

$\bar{u}$ = *corrected velocity in x-direction* (m/s)

ρ = *VOC concentration* $(\mu g/m^3)$

Basis of calculations:

- The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
- Wind velocity data given by Aegis Terminal as per weather monitoring station provided at site.
- Strong solar radiation and unstable air conditions are assumed.

The Aegis tanker loading loss data is as follows:

Product	**Product Gantry Vapour Control System Vent Pipe height (mtr)**	***Loading Loss (kg/day)**
Mix-Xylene	14	0.0179
Ortho-Xylene	14	0.00647
Styrene Monomer	14	0.108
Methanol	14	0.602
Toluene	14	0.241
VAM	14	0.0443
Dimethyl Formamide	14	0.000954
Acetone	14	0.914

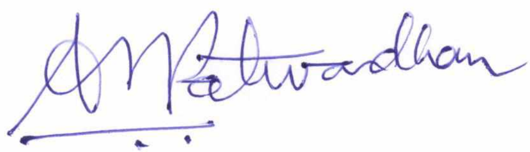
The calculations summary for the above mentioned products is given on the following pages.

Mixed Xylene (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0179	kg/day
Q	2.073E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00119	µg/m^3 ... from Eq. (3)

Ortho Xylene (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.006469	kg/day
Q	7.487E+01	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.000429	µg/m^3 ... from Eq. (3)

Styrene Monomer (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.108	kg/day
Q	1.250E+03	µg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00717	µg/m^3 ... from Eq. (3)

Methanol (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.602	kg/day
Q	6.970E+03	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0400	μg/m^3 ... from Eq. (3)



Toluene (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.2412	kg/day
Q	2.792E+03	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0160	µg/m^3 ... from Eq. (3)

VAM (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.04	kg/day
Q	5.132E+02	μg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00294	μg/m³ ... from Eq. (3)

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Dimethyl Formamide (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.000954	kg/day
Q	1.104E+01	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0000633	µg/m^3 ... from Eq. (3)

Acetone (Aegis Tanker Gantry)		
H (vent pipe emission point)	14	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.914	kg/day
Q	1.058E+04	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.49	m/s
x	1450	m (distance from Aegis)
y	0	m
z	0	m
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.0607	µg/m^3 ... from Eq. (3)

Appendix 2 - VOC concentration - Aegis ETP

$$\begin{cases} \bar{u}_1 = \bar{u}\left(\dfrac{z_1}{H}\right)^{\alpha} \quad \ldots (Eq.\ 1) \\ \alpha = 0.5 \text{ for stable conditions; } \alpha = 0.25 \text{ for unstable conditions} \end{cases}$$

$$\begin{Bmatrix} \sigma_y = \text{speading coefficient} = a \cdot x^{0.903} \\ \sigma_z = \text{speading coefficient} = b \cdot x^{p} \end{Bmatrix} \quad \ldots (Eq.\ 2)$$

$$\langle \rho \rangle (x, y, z, H) = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot \bar{u}} \exp\left[\underbrace{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2}_{\text{horizontal component}} \right] \cdot \left\{ \underbrace{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]}_{\text{vertical component}} \right\} \quad \ldots (Eq.\ 3)$$

x = logitudinal straight distance from the source tank (m)

y = horizonal component from the source tank = 0

z = vertical component from the source tank = 0

H = tank height

Q = source strength of VOC $(\mu g/s)$

$\bar{u}$ = corrected velocity in x-direction (m/s)

ρ = VOC concentration $(\mu g/m^3)$

Basis of calculations:

- The STANDARD HEIGHT (z_1) is a concept used for STANDARDISATION of wind velocity.
- Wind velocity data given by Aegis Terminal as per weather monitoring station provided at site.
- Strong solar radiation and unstable air conditions are assumed.
- Emission point height is taken from ground level considering foundation height and roof nozzle height in addition to tank height.

The Aegis ETP tank emission data is as follows:

Sr. No.	Product	Type of Tank	Tank Ht (mtr)	Emission Point on tank top (mtr)	Total Emission (kg/day)
1	Collection Tank	VFR	4.0	5.0	0.0302
2	Primary Settling Tank	VFR	3.0	4.0	0.0259
3	Equalisation Tank 1	VFR	3.0	4.0	0.0262
4	Equalisation Tank 2	VFR	3.0	4.0	0.0259
5	Buffer Tank	VFR	2.0	3.0	0.0256
6	Sludge Tank	VFR	2.0	3.0	0.0257

The calculations summary is given on the appended pages.

Collection Tank (Aegis ETP)		
H (emission point)	5	m
Tank height	4	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0302	kg/day
Q	3.491E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	1.93	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00201	$\mu g/m^3$ ... from Eq. (3)

Primary Settling Tank (Aegis ETP)		
H (emission point)	4	m
Tank height	3	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0259	kg/day
Q	2.993E+02	μg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	2.04	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00172	μg/m^3 ... from Eq. (3)

Equalisation Tank 1 (Aegis ETP)		
H (emission point)	4	m
Tank height	3	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0262	kg/day
Q	3.038E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	2.04	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00175	µg/m^3 ... from Eq. (3)

Equalisation Tank 2 (Aegis ETP)		
H (emission point)	4	m
Tank height	3	m
z_1	*10*	*m (mandatory parameter in Eq. (1)*
Q	0.0259	kg/day
Q	3.003E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	2.04	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00173	$\mu g/m^3$ ... from Eq. (3)

Buffer Tank (Aegis ETP)		
H (emission point)	3	m
Tank height	2	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0256	kg/day
Q	2.964E+02	µg/s
α	0.25	
$\bar{u}$	1.62	m/s
$\bar{u}_1$	2.19	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00171	$\mu g/m^3$ ... from Eq. (3)

Sludge Tank (Aegis ETP)		
H (emission point)	3	m
Tank height	2	m
z_1	10	m (mandatory parameter in Eq. (1)
Q	0.0257	kg/day
Q	2.977E+02	µg/s
α	0.25	
ū	1.62	m/s
$\bar{u}_1$	2.19	m/s
x	1450	m (distance from Aegis)
a	0.295	Parameter in Eq. (2): depends on $\bar{u}_1$
b	0.0579	Parameter in Eq. (2): depends on $\bar{u}_1$
p	1.09	Parameter in Eq. (2): depends on $\bar{u}_1$
σ_y	211.124	m ... from Eq. (2)
σ_z	161.648	m ... from Eq. (2)
ρ (VOC concentration)	0.00171	µg/m^3 ... from Eq. (3)

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