BEFORE THE NATIONAL GREEN TRIBUNAL, PRINCIPAL BENCH, NEW DELHI

OA 2456 of 2022

SUBMISSION OF HUMAN RIGHTS FORUM, ANDHRA PRADESH

1. It is submitted that Human Rights Forum (HRF), a rights based organization in the States of Andhra Pradesh and Telangana has been working with the affected villagers since the public hearing stage for the environmental clearance of the uranium mining and processing project of UCIL at Tummalapalle. Late Smt K Jayasree, our founding member has been a source of support for the people that lost their goats and sheep due to diseases from pollution, for the farmers who had to abandon farming the land due to contaminated groundwater, and for people that became sick. She helped farmers fight for compensation for the land taken but compensation was not paid. In one case, the tailings transfer pipe passing through a farmer's land breached creating toxic puddles of hazardous waste. Several cattle entered these puddles, drank that liquid thinking it as water were severely hurt with alkali burns. Some of the cattle died. She helped him approach AP High Court for justice. Case is still pending. She took the sick to hospitals for treatment and followed up on their health condition. Several of them died. She guided the farmer who first recognized the drying out of his banana plants to get the groundwater and soil tested at Krishi Vigyan Kendra, Kadapa which declared the groundwater unfit for irrigation. She took him to the Collector with a representation. A committee of district officials was formed but no report came from it. Later she visited the tailing pond with some farmers and observed that the lining specified by MoEF&CC and APPCB is absent. Later through Internet searches, it became known that the Regional Office of MoEF&CC, Chennai inspected UCIL in December 2016 and issued an inspection report dated 4.1.2017 listing 9 violations of the conditions prescribed in EC. Inspection was done as it was mandatory to obtain a compliance certificate to get ToR for the expansion project. It is 5 years since but no action is taken to enforce implementation. Smt Jayasree expired in 2021. HRF would like to represent the affected people for the protection of their rights.
2. We are surprised at Hon'ble NGT asking for the opinion of DAE ignoring the severe conflict of interest of DAE as UCIL is its constituent part. DAE cannot offer an independent opinion. It just repeated the same arguments made by BARC on behalf of UCIL.
3. DAE opinion submitted states "As per the directives of APPCB, polyethylene and bentonite clay lining is to be laid for Thickened Tailing Disposal Area (TTD). Presently, thickened tailings are not generated from the plant and polyethylene lining is not applicable."

4. This is a highly illogical argument. We wonder how a premier scientific body made such a ridiculous claim. APPCB should answer why they specified Thickened Tailings Disposal (TTD). UCIL claimed in the EIA of 2006 "The state of the art technologies will be used for tailings pond commissioning, tailings management, effluent treatment, radiological surveillance, and tailings pond decommissioning as well as to ensure environmental radiation protection measures effectively." It was probably UCIL in their presentations for obtaining CFE from APPCB told the expert committee that they propose to deposit tailings as TTD to reduce seepage. We cannot think of APPCB officials knowing about TTD otherwise. If APPCB considered two layers of lining necessary for TTD, a slurry of tailings containing highly alkaline liquid part with sodium salts requires better protection against seepage. More stringent lining becomes essential. The argument by the progeny of DAE is illogical and unscientific. It is deeply disturbing that the prestige of the department is being used against poor farmers suffering from loss of agricultural land and livelihood.
5. Prof E. I. Robinsky of U Toronto developed the concept of Thickened Tailings Disposal in 1973 at the Kidd Creek Mine at Timmins in Canada. Original vision of central thickened discharge (CTD) was realized only in 1995 after several iterations of thickener upgrade. However, it is successfully implemented in very arid regions of Australia. Using TTD eliminates the need for the construction of high and costly confining dikes and dams. If UCIL adapted TTD then building a Tailings dam with borrowed soil at a cost of about Rs 35 crores could be avoided and seepage problem eliminated. According to Robinsky "The most damaging aspect of tailing disposal is usually seepage into the surrounding environment. Such seepage cannot be prevented entirely, but the thickened tailing disposal system creates less contamination than conventional methods"

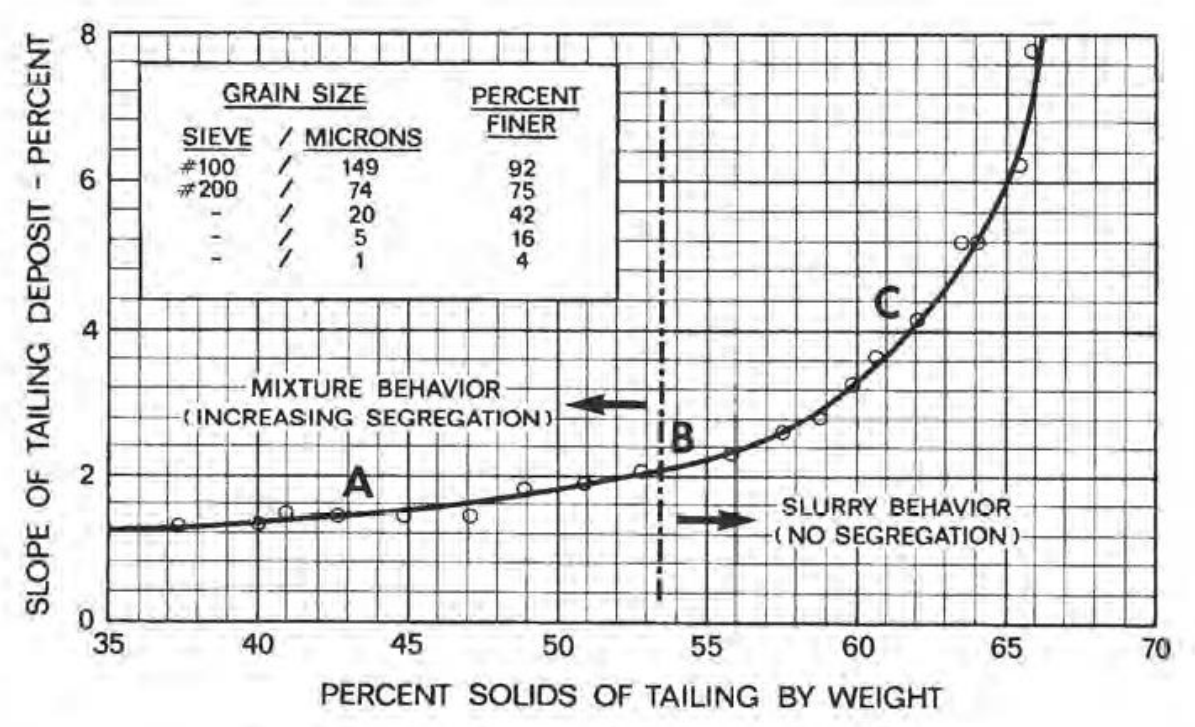


Figure 2 Typical laboratory tailing deposition test results

"As a tailing is thickened it progressively changes from a mixture of solid particles and liquid to a non-segregating slurry. The state at which the latter occurs is the minimum percent solids to which any tailing must be thickened. Typically, a slurry of this consistency will stand at slopes of 1 to 2 percent. Additional thickening will result in steepening of the deposited slope at an ever-increasing rate. Figure 2 illustrates typical laboratory tailing deposition test results." Tailings qualify as thickened after point B in Figure 2.

6. "Disposal by the thickened tailing discharge system has certain advantages over the conventional approach with regard to reducing the amount of seepage into the underlying soil formations.
7. The sloped tailing deposit is not contained by dikes, or has much smaller dikes and therefore seepage through such structures is either eliminated or at least greatly reduced.
8. By the elimination of the slimes pond the free hydrostatic head which is found on conventional disposal areas is also eliminated. Without a free head of liquid above the tailing surface, any downward seepage movement will be immediately arrested by the development of a substantial capillary rise potential (suction). This will occur because the fines in the tailing are disseminated throughout the mass and it is the fine fraction which contributes most to the capillary forces. Capillary rise in the typical fine fraction of mine tailing can theoretically attain 150 or more feet."

[E. Robinsky, “Thickened Tailing Disposal in Any Topography” in Don Donaldson and Benny E. Raahauge (Eds.), “Essential Readings in Light Metals, Volume I, Alumina and Bauxite”, Springer International Publishers, p933-937, 2016]

9. Expert committee appointed by APPCB in its report dated 10.09.2019 observed: “The committee observed with great concern that the tailings are dumped in the tailing pond in the form of slurry through outfalls at multiple locations around the pond. Most of these outfalls are directly falling on the pond abutments causing significant erosion and greatly increasing the likelihood of seepage through fractures/bedding planes in the abutting sedimentary strata into the groundwater table.”

A tailing slurry discharge to the pond. Slurry is discharged onto the land without any protection against seepage. Soil eroded due to impingement of discharge stream is visible. Deep crevices are cut into the soil by flowing tailing slurry. White patches are salt deposits. UCIL denies any seepage from the Tailings Pond. We observed that as we put water above the edge of the tailings pond all the water simply disappears down the soil of the abutment. Where is the clay lining?

“As per AERB guidelines, the bottom of tailing pond is lined with natural clay. The low permeability of clay lining ensures that the migration is contained within the tailing pond and there is no possibility of percolation of tailing water into groundwater.” [DAE opinion]

UCIL Tailing Pond picture of 2018 clearly shows that there is no lining, not even clay lining as per AERB guidelines. Trees within the pond and grass, plants, and trees on the unsubmerged edges tell the real story of dumping the tailings without any care to prevent seepage of the highly alkaline slurry deposited in the pond along with solid tailings. Public-funded institutions lying so blatantly against public safety is worrisome.

White layer on top of the tailings comprises the salts from the alkaline leach process discharged as a slurry with tailing. These very salts in a dissolved state have reached the groundwater through seepage and made the water unfit for irrigation.

10. Seepage can be estimated using engineering methods. Engineers have helped make the calculations for the UCIL tailing pond considering the clay lining with a permeability of 10^{-9} m/s as claimed by UCIL and DAE.

Basis: Seventh Arthur Casagrande Lecture by Prof Kerry Rowe published in Canadian Geotechnical Journal in January 2012.

[Rowe. K, "Short- and Long-term leakage through composite liners", Canadian Geotechnical Journal, 49, p141-169, 2012]

11. We shall first attempt to reproduce the leakage rates presented in table 5 of the publication for Compacted Clay Liners (CCL) and then calculate the leakage for the UCIL tailings pond at Kottala village using available data.

Table 5. Calculated leakage through a single primary clay liner for lower bound hydraulic conductivity (GCL $k_L = 7 \times 10^{-12}$ m/s, $H_L = 0.01$ m; CCL $k_L = 1 \times 10^{-10}$ m/s, $H_L = 0.6$ m). Refer to Figs. 4 and 5.

Liner	H_A (m)	h_a (m)	Q (lphd) $h_w = 0.3$ m	$h_w = 5$ m
GCL	0	0	190	3000
CCL	0	0	130	810
GCL	0.59	0	540	3400
GCL	3.74	3	620	3400
CCL	3.15	3	150	820

The above Table shows, that even with the permeability nearly a thousand times smaller for GCL (rows 1, 3 and 4) compared to the AERB guideline for lining tailing ponds, there is considerable seepage.

For the flow-through Soil and liners, Darcy's law is applicable

Darcy law: Q = kIA Where k = Permeability cm/s or m/s

I = Hydraulic gradient = h/L

Where h = pressure head, m

L = height of the soil layer, m

A = Area of seepage, m^2

Q = volumetric flow rate, m^3/sec

Fig. 4. Single primary clay liner over a LDS.

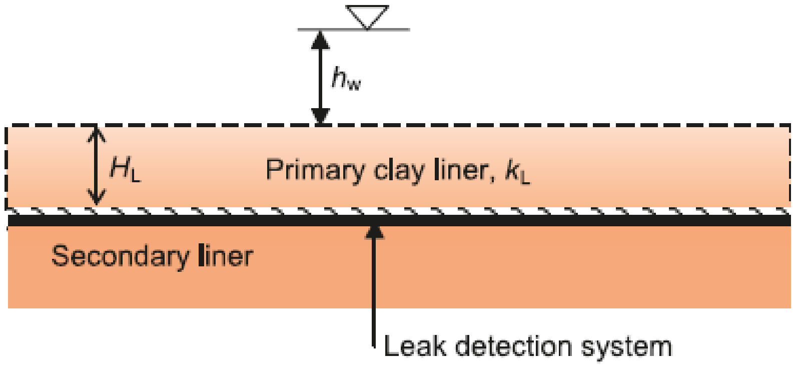
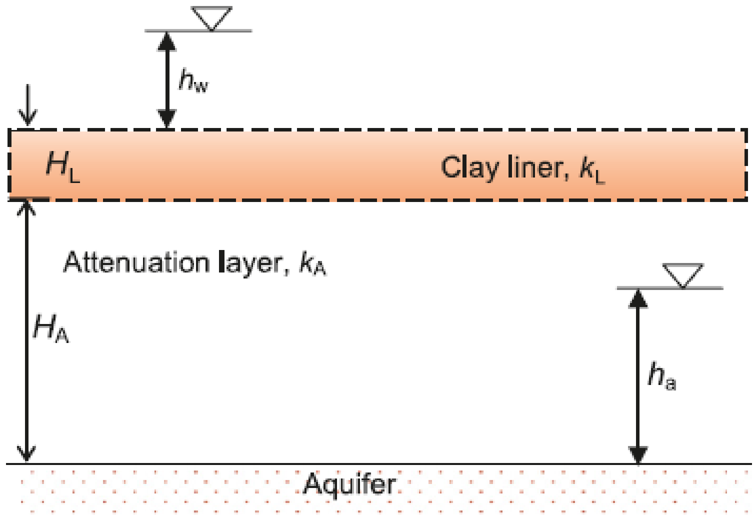


Fig. 5. Clay liner over an attenuation layer and aquifer.



Attenuation layer is the normal soil layer in between the lining and the groundwater table.

H_A is the thickness of the soil layer or the depth of the water table below the surface in m.

h_a is the piezometric head in m of the groundwater

With no Attenuation Layer, seepage for CCL:

$k_L = 10^{-10}$ m/s

$h_w = 0.3$ m

H = 0.3 + 0.6 = 0.9 m

L = 0.6 m

A = 10000 m^2

Q = 10^{-10} x 0.9/0.6 x 10000 = 1.5 x 10^{-6} m^3/ha/s = 1.5 x 10^{-6} x 1000 x 3600 x 24

= 129.6 lphd = **130 lphd** [Second row, fourth column in the Table 5] lphd = litres per hectare per day

For h_w = 5.0 m I = (5.0 + 0.6) /0.6 = 9.333

Q = 10^{-10} x (5.0 + 0.6) /0.6 x 10000 = 9.333 x 10^{-6} m^3/s

= 9.333 x 10^{-6} x 3600 x 24 x 1000 = 806.4 lphd = **810** lphd (rounded) [Second row, last column of Table 5]

With Attenuation layer, Seepage rate for CCL:

h_w = 0.3 m

I = $(h_w + H_L + H_A – h_a)/(H_L + H_A)$

$k_{eq} = (H_L + H_A)/(H_L/k_L + H_A/ k_A)$

For this problem

h = $(h_w + H_L + H_A – h_a)$ = (0.3 m + 0.6 m + 3.15 m – 3 m)= 1.05 m

L = 0.6 m + 3.15 m = 3.75 m

So I = h/L = 1.05 m/3.75 m = 0.28

Let us take the area for seepage = 1 Ha = 10,000 m^2

k_A = 10^{-7} m/s (Given 0n page 142 of the paper in the journal)

k_{eq} = 3.75 m/(0.6 m/10^{-10} m/s + 3.15 m /10^{-7} m/s)

k_{eq} = (3.75 m /6.0315 x 10^{9} s) = 6.217 x 10^{-10} m/s

Q = 6.217 x 10^{-10} x 0.28 x 10^4 m^3/Ha/s = 1.74 x 10^{-6} m^3 per Ha per s

= 1.74 x 10^{-6} x 3600 x 24 x 1000 = **150** lphd [Last row, fourth column in the Table 5]

Leakage rates match with the figures given in the Table 5 above for both the cases.

For h_w = 5.0 m

h = $(h_w + H_L + H_A – h_a)$ = (5.0 m + 0.6 m + 3.15 m – 3 m) = 5.75 m

L = 0.6 m + 3.15 m = 3.75 m

I = h/L = 5.75/3.75 = 1.533

K_{eq} = 6.217 x 10^{-10} m/s (Same as the previous case)

Q = 6.217 x 10^{-10} x 1.533 x 10^4 = 9.53 x 10^{-6} m^3/s x 3600 x 24 x 1000 lphd

= 823 lphd = **820** lphd (rounded) [Last row, last column of Table 5]

12. UCIL Tailings Pond Leakage Rate

Having reproduced the leakage rates presented in Prof K Rowe's paper, we shall now attempt to calculate the leakage rate for the UCIL tailings pond at Kottala.

A conservative estimate of the minimum leakage for the existing pond at Kottala is attempted here. Field permeability testing data given to district administration on demand from people shows a variation from a high value of 3.29 cm/s to as low as 10^{-7} cm/s at one depth in one case. Overall most of the values are in the vicinity of 10^{-2} cm/s. Complete lithology profile of the soil down to the groundwater table is not done. About 20 locations were chosen and tests were done to a maximum depth of 20 m only. FPT was done at two or three depths within the 20 m.

Assumptions:

1. Groundwater table depth H_A= 200 m
2. Piezometric head of groundwater h_a= 15 m
3. Permeability of soil layer k_A= 10^{-4} cm/s
4. Thickness of compacted layer H_L = 0.15 m
5. Permeability of compacted layer k_L = 10^{-7} cm/s
6. Hydraulic head of water in the pond h_w= 0.5 m

All the values taken above in absence of precise data are to produce lower leakage.

h_w = 0.5 m; k_L = 10^{-7} cm/s = 10^{-9} m/s; k_A = 10^{-4} cm/s = 10^{-6} m/s; H_L = 0.15 m; H_A = 200 m; L = 0.15 + 200.0 = 200.15 m;

$h = (h_w + H_L + H_A – h_a) = 0.5 + 0.15 + 200.0 – 15 = 185.65$ m

I = 185.65/200.15 = 0.92755

$k_{eq} = (H_L + H_A)/(H_L/k_L + H_A/ k_A)$

$= (0.15 + 200.0)/(0.15/10^{-9} + 200.0/10^{-6})$

$= 200.15/(1.5 \times 10^{8} + 200.0 \times 10^{6})$

$= 200.15/(3.5 \times 10^{8}) = 57.186 \times 10^{-8} = 5.7186 \times 10^{-7}$ m/s

$Q = 5.7186 \times 10^{-7} \times 0.92755 \times 10000 = 5.3 \times 10^{-3}$ m^3/ha/s

$= 5.3 \times 10^{-3} \times 3600 \times 24 \times 1000 =$ **<u>457920</u>** <u>lphd</u>

This is the least quantity of potential leakage that could occur if the water level in the pond could be maintained at 0.5 m.

Taking the hydraulic head for seepage in the tailings pond as 0.1 m

$h_w = 0.1$ m; $k_L = 10^{-7}$ cm/s $= 10^{-9}$ m/s; $k_A = 10^{-4}$ cm/s $= 10^{-6}$ m/s; $H_L = 0.15$ m; $H_A = 200 - 0.15 = 199.85$ m; $L = 0.15 + 200.0 = 200.15$ m;

$h = (h_w + H_L + H_A - h_a) = 0.1 + 0.15 + 200.0 - 15 = 185.25$ m

$I = 185.25/200.15 = 0.92556$

$k_{eq} = (H_L + H_A)/(H_L/k_L + H_A/ k_A)$

$= (0.15 + 200.0)/(0.15/10^{-9} + 200.0/10^{-6})$

$= 200.15/(1.5 \times 10^{8} + 200.0 \times 10^{6})$

$= 200.15/(3.5 \times 10^{8}) = 57.186 \times 10^{-8} = 5.7186 \times 10^{-7}$ m/s

$Q = 5.7186 \times 10^{-7} \times 0.92556 \times 10000 = 5.29 \times 10^{-3}$ m^3/s

$= 5.29 \times 10^{-3} \times 3600 \times 24 \times 1000 =$ **<u>457056</u>** <u>lphd</u>

Taking $h_w = 0.0$ m and the compacted layer thickness H_L as 0.5 m as suggested by APPCB, the seepage estimate is:

$h = (h_w + H_L + H_A - h_a) = 0.0 + 0.50 + 200.0 - 15 = 185.50$ m

$I = 185.50/200.5 = 0.9252$

$k_{eq} = (H_L + H_A)/(H_L/k_L + H_A/ k_A)$

$= (0.50 + 200.0)/(0.50/10^{-9} + 200.0/10^{-6})$

$= 200.50/(5.0 \times 10^{8} + 200.0 \times 10^{6})$

$= 200.50/(7.0 \times 10^{8}) = 28.642 \times 10^{-8} = 2.8642 \times 10^{-7}$ m/s

$Q = 2.8642 \times 10^{-7} \times 0.9252 \times 10000 = 2.65 \times 10^{-3}$ m^3/s

$= 2.65 \times 10^{-3} \times 3600 \times 24 \times 1000 =$ **228960** lphd

Considering the recommendation of the expert committee increasing the thickness of compacted layer to 1.5 m leads to:

$h = (h_w + H_L + H_A – h_a) = 0.0 + 1.50 + 200.0 – 15 = 186.50$ m

$I = 186.50/201.5 = 0.92556$

$k_{eq} = (H_L + H_A)/(H_L/k_L + H_A/ k_A)$

$= (1.50 + 200.0)/(1.50/10^{-9} + 200.0/10^{-6})$
$= 201.50/(15.0 \times 10^8 + 200.0 \times 10^6)$
$= 201.50/(17.0 \times 10^8) = 11.853 \times 10^{-8} = 1.1853 \times 10^{-7}$ m/s

$Q = 1.1853 \times 10^{-7} \times 0.92556 \times 10000 = 1.097 \times 10^{-3}$ m^3/s

$= 1.097 \times 10^{-3} \times 3600 \times 24 \times 1000 =$ **94786** lphd

Even a lining of 1.5 m thickness will not prevent seepage without impermeable layer.

The calculations indicate, hydraulic head has barely any effect on the leakage rate,

13. Above results show that the tailings pond existing has enormous capacity to leak. Any liquid discharged into the tailings pond finds its way to the groundwater. Limiting factor is the quantity of liquid in the pond.

14. Water balance presented in the EIA for the expansion project in 2011 shows a water content of 1630 m^3/d going with the tailings to the pond. All that water contaminated with chemicals could end up in the groundwater as the potential to leak surpasses the quantity available. Without a properly designed barrier to prevent leakage, groundwater contamination is inevitable.

15. AERB should provide the basis for stipulating 10^{-9} m/s permeability lining as protective of groundwater. They should present calculations showing negligible seepage at that permeability.

UCIL is the culprit for groundwater contamination. They are legally liable for the environmental crime of poisoning the commons i.e., the groundwater.

16. APPCB after several complaints and protests by affected people; sponsored a groundwater study to determine the cause of contamination at a cost of Rs51 lakhs to IIT, Madras. But the report is kept secretive. Hon’ble NGT may please direct APPCB to submit a copy and also upload it on the APPCB website. Public funding is spent for the study, but the public is not informed of the outcome.
17. Therefore for the above state reasons the Human Rights Forum humbly seeks justice for affected farmers and villagers and prays that the Honourable Tribunal may issue directions to the Ministry of Environment, Forest and Climate Change and the Andhra Pradesh Pollution control Board

    i. eliciting the actions taken by APPCB after serving several show-cause notices
    ii. Any other relief of reliefs that the Honourable Tribunal deems fit in the interest of justice

(K Sudha)

General Secretary, Human Rights Forum,

Andhra Pradesh