

Fingerboards Mineral Sands Project — Inquiry and Advisory Committee (IAC)

Expert meeting statement — Suitability of centrifuges to recover water from tailings from the Fingerboards Project

Meeting held 1st April 2021 at Epac P/L Offices. Reviewed and agreed for execution on 16th April 2021 by video link

Experts: Ivan Saracik (for Proponent) Conleth O'Loughlin (for Environmental Justice Australia)

Observers: None

Note taker: Ivan Saracik

The following key issues and areas of agreement and disagreement were identified by the participating experts at the meeting:

Item No.	Issue	
1.	Technical performance of centrifuges in removing water from tailings.	
	No.	Agreed fact/opinion
	1.1.	<p>The Fingerboards Project is committed to a tailings disposal system using sold bowl decanting centrifuges to recover water from tailings prior to disposal within the mined out voids. The earlier tailings disposal dam proposal as set out in the Fingerboards Environmental Effects Statement (EES) has now been discarded. That proposal relied on the tailings slurry settling naturally over a period of time and entrained water being released for recovery, with little evaporation loss. The current plan using centrifuges and the background to the change from the use of a tailings dam is set out in Technical Note; as referenced.¹</p> <p>The two Experts are in agreement that the use of bowl centrifuges to accelerate the dewatering of tailings, most particularly fine tailings, is technically feasible and has been used successfully in other mines, albeit not for mineral sand tailings. The dewatering process produces dried tailings ('cake') in a physical state that can be transported and placed within the mined out voids. The Experts believe that based on the positive results achieved in the test programs, it should be possible to design and construct a plant that will separate all free moisture from the tailings, for return to the process circuit and reuse. This will facilitate the in-pit permanent storage of a dried tailings that has the solids content and strength to be trucked and deposited safely and such that there is no free moisture to be leached out to the environment.</p>

¹ 43_Kalbar – Technical Note 01 – Implementation of centrifuges for water recovery and tailings management - 18 01 21

Individual comments in respect of agreed fact/opinion	
Ivan Saracik	<p>The default method of choice to store tailings from mines has been and continues to be in tailings impoundments. These have water recovery systems, either penstock or floating return water pump based. Either can be designed to work effectively where the solid particles settle and a clear solution is generated. A penstock system allows for water to be collected in a fixed location vertical round or rectangular tower structure with the height controlled by weirs or pipe sections. A floating return water pump system allows more flexible location of the floating system.</p> <p>Tailings settlement in ponds/dams does not occur effectively with fine clayey materials. Maximising water recovery from fine mineral sands tailings necessitates mechanical process units, those with the highest centrifugal forces to achieve the separation being centrifuges.</p> <p>Where the material is extremely fine as is the case at Fingerboards, relying on gravity to separate the water to a suitable level of clarity and with sufficient recovery is not effective. It results in tailings being spread over large areas of land and in increased water usage as water is not released by the solids stored. As unused land is not available in East Gippsland and water usage is vitally important to local inhabitants, discarding the use of tailings dams, be they temporary or permanent, at Fingerboards is considered to be totally appropriate.</p> <p>There are filter process units that are used extensively in mining operations to liberate water from solids. These include pressure filters of more than one type and belt filters. Generally, if not exclusively, these work in mining operations where comminution circuits are used to liberate minerals and in these cases the tailings will typically be at a fineness where 50% of the tailings will be finer than in a range of 30 – 50 microns.</p> <p>For comparison, the Fingerboards tailings has a fineness where 65 -70% of the tailings is finer than 11 microns. The only known technological piece of equipment that will remove all moisture other than that inherent in the structure from a material this fine, is a centrifuge due to the high centrifugal forces this equipment generates.</p> <p>The capital and operating costs of these machines are higher than any alternative filtration units, but none of these can achieve similar outcomes.</p> <p>The mineral sands processing methods, generally and certainly at Fingerboards do not involve toxic reagents in the processing circuit. The controlled addition of flocculant traditionally to aid in settling solids in tailings impoundments or to render the solids able to be handled and trucked to be co-deposited with mine waste/overburden is a well proven technology. The flocculant proposed for use at Fingerboards is the same as that used in many mining operations worldwide. Polymer LT 27 (Magnafloc LT2), an anionic polyacrylamide flocculant is also added by East Gippsland Water to the centrifuge circuits for Bairnsdale and other localities as a flocculation aid to increase settlement rate of suspended solids in the coagulation process².</p>
Conleth O'Loughlin	No further comments.

² East Gippsland Water – Water Quality Annual Report 2019/20

2.	Lack of performance certainty of centrifuges for dewatering mineral sand tailings in a commercial setting.	
	No.	Agreed fact/opinion
	2.1.	<p>Centrifuges similar in scale to those proposed for Fingerboards have been used in mining operations, drying tailings and tar sands on a commercial scale. Centrifuges have not been installed in any mineral sands mines drying tailings on a commercial scale.</p> <p>A small scale program of centrifuge spin testing was carried out on Fingerboards tailings by Alfa-Laval in 2018, using a laboratory centrifuge. During April 2021, (and since the expert statements of Saracik and O’Loughlin were submitted to the Inquiry and Advisory Committee) a further laboratory test programme has been completed using both a desktop centrifuge and a larger, 200mm diameter centrifuge (model P1-100), which delivered a dried tailings with a solids content in the range of 60% to 63% in five tests. The tailings feed rate in these latter centrifuge tests ranged from 39 to 51 kg/hr. As of the date of writing this Joint Statement preliminary results of the first two days of the P1-100 trial have demonstrated the production of a spadeable cake that can be handled and trucked for back filling into the mined out voids. These laboratory test programmes have delivered suitable performance figures that support the selection of decanter centrifuges for dewatering the Fingerboards tailings. Any proposal to establish a trail mining pit and larger scale centrifuge operation at the Fingerboards site is supported by the Experts.</p>
	<p>Assumptions relied upon in reaching agreement</p> <ol style="list-style-type: none"> 1. Documented results from the initial spin tests on Fingerboards tailings using a laboratory scale centrifuge 2. Initial test reports received 15 April 2021 with outcomes of the first two days of tests on Fingerboards tailings using a 200mm diameter P1-100 decanter centrifuge. A Draft Report entitled “Summary of centrifuge testwork completed at Nagrom and Alfa Laval” dated 9th April 2021 has been received from Wave International and has been sighted by the Experts. It is anticipated that a formal issue of this Draft Report will be received in the immediate future and this will then form part of the agreed discovery documentation before the Panel. 	
	Individual comments in respect of agreed fact/opinion	
	Ivan Saracik	<p>The default method to store tailings from mines is in tailings impoundments. These have water recovery systems, either penstock of floating return water pump based. Either can be designed to work effectively where the solid particles settle and a clear solution is generated. A penstock system allows for water to be collected in a fixed location vertical round or rectangular tower structure with the height controlled by weirs or pipe sections. A floating return water pump system allows more flexible location of the floating system.</p> <p>Where the material is extremely fine as is the case at Fingerboards, relying on gravity to separate the water to a suitable level of clarity and with sufficient recovery is not feasible.</p> <p>There are filter process units that are used extensively in mining operations to liberate water from solids. These include pressure filters of more than one type and belt filters, which are only able to work in mining operations where comminution circuits are used to liberate minerals and in these cases the tailings will typically be at a finesses where 50% of the tailings will be finer than a range of 30 – 50 microns.</p> <p>For comparison, the Fingerboards tailings has a fineness where 65 -70% of the tailings is finer than 11 microns. The only recognised technological piece of equipment that will remove all moisture other than that inherent in the structure is a centrifuge due to the high centrifugal forces this equipment generates.</p> <p>The capital and operating costs of these machines would be higher than any of the alternative systems, particularly where available land is plentiful and water usage is not as critical as is the case in East Gippsland.</p>

			<p>The Testwork program conducted during the week ending 9th April 2021 using a P1-100 200mm centrifuge has produced positive results aligned with the laboratory spin test in 2018. A future scaled up test program is scheduled to be conducted at the Site using material from a Fingerboards trial pit and using local water. This test is planned using a P2-405 centrifuge with a diameter of 440 mm and this machine can handle approximately 6 t/hr, but can only be carried out when approval is forthcoming to excavate a trail mining pit.</p>
		<p>Conleth O'Loughlin</p>	<p>The results from the initial sets of laboratory tests provide some level of confidence that centrifuges <i>should</i> work effectively at full scale during operation of the proposed Fingerboards mine. However, as centrifuges have not been used commercially on mineral sands tailings at field scale, an unacceptable level of uncertainty remains, particularly as no acceptable alternative approach has been proposed should centrifuges prove to be unworkable at the Fingerboards site. It is my recommendation that a pilot programme is conducted at the Fingerboards site using both local water and the Fingerboards tailings and using decanter centrifuges that are a step-up in scale from the decanter centrifuges used in the April 2021 laboratory trials. Results from such field trials would be an important qualifier for reducing uncertainty and establishing the likely effectiveness of decanter centrifuges for the Fingerboards tailings.</p> <p>High level information provided to me indicate that the composition, density and particle size distribution of the Fingerboards tailings is similar to other tailings that have been dewatered using decanter centrifuges (in operating mines), My view is that this should be demonstrated more thoroughly as should this prove to be the case, it would provide further confidence in the effective use of decanter centrifuges for the Fingerboards tailings. It is my view that it would be prudent and reasonable to expect Kalbar or Alfa-Laval to demonstrate this logic by comparing the results from the laboratory scale centrifuge trials on the Fingerboards tailings with similar scale trials on other tailings that have also been dewatered using centrifuges in operating mines.</p>

3.	Confirmation of the design basis for the P3-10070 centrifuges proposed for Fingerboards
Matters discussed by Experts	
No.	Actions and cautions
3.1.	<p>It is recognised that the Fingerboards Project is based on the installation of eight mechanical process units (decanter centrifuges) and that Alfa-Laval have supplied, installed and commissioned many of these exact units on tailing operations, although none of these have operated on mineral sands.</p> <p>Comparisons of the tailings properties of expected Fingerboards tailings and other example tailings made available by Alfa-Laval to the experts indicate comparable density, solids and mineral content, such that the demand on the centrifuges proposed for Fingerboards should not exceed that in the centrifuge dewatering operations for these example tailings.</p> <p>A total of eight centrifuges across two centrifuge plants are proposed with six operating at any time, such that at each of the two centrifuge buildings there would be a standby centrifuge.</p> <p>The prospective supplier Alfa-Laval have developed, supplied and installed numerous decanter centrifuges for various industries, including the mining industry. The Experts have sighted an email from Alfa-Laval to Wave International, the engineering company acting for Kalbar, that outlines that Alfa-Laval's centrifuges are designed in accordance with relevant international standards for centrifuges (specifically European Standard EN 12547:2014) which includes at Clause 5.2.1.2, the requirement to <i>"having a casing capable of containing loosened or broken rotor parts, for example a casing manufactured of steel withstanding and containing the energy of the parts and deforming of the parts and/or the casing"</i>.</p> <p>In the implementation phase, the details that should be considered include:</p> <ul style="list-style-type: none"> – containment systems to protect persons and equipment in the unlikely event of a mechanical failure of the rotating parts of the centrifuge; – wear of componentry and maintenance regimes to ensure continuity of operation; – condition monitoring, ensuring that instrumentation measurements are monitored relative to 'healthy' baselines and alerts/shutdown initiated when thresholds are exceeded; and – foundation rigidity and settlement to ensure safety and performance of the centrifuges during operation.
Assumptions relied upon in reaching agreement	
<p>Alfa-Laval have provided the Experts with a package of three documents setting out their Operating Manual, General requirement for electrical equipment and control systems for decanters and EN 12547-2014 Common safety requirements, all pertinent to the proposed Fingerboards decanter centrifuges.</p> <p>The assumptions made are that:</p> <ul style="list-style-type: none"> – the centrifuge design meets and facilitates the outcomes in the three documents above, in particular that the centrifuges proposed for the Fingerboards project are designed in accordance with relevant international standards for centrifuges (e.g. European Standard EN 12547:2014) that stipulate that centrifuges must be designed to contain rotating elements in the event of a catastrophic failure; and – during the implementation phase that HAZOP workshops are conducted that will ensure due diligence is applied during the entire project implementation phase. 	

Individual comments in respect of agreed fact/opinion	
Ivan Saracik	No comment
Conleth O'Loughlin	<p>Having been provided with further documentation on the design basis for the Alfa-Laval decanter centrifuges and information from Alfa-Laval (since the date of my expert statement), I am satisfied that the centrifuges proposed for the Fingerboards project will not pose an unreasonable safety risk provided that:</p> <ul style="list-style-type: none"> • the centrifuges are designed to fully contain rotating elements in the event of a catastrophic failure (i.e. as required by relevant international standards, e.g. European Standard EN 12547:2014); and • the instrumentation used to monitor vibration, bearing temperature and rotor torque are used as feedback in the control, such that the centrifuge would alert an operator or shutdown the centrifuge should the instrumentation measurements exceed thresholds for action and shutdown respectively.

Prepared jointly by:



Ivan Saracik

16th April 2021



Conleth O'Loughlin

16th April 2021