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Internal memo

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Mesa J Flocculant Concentration in Waste Fines Storage

INTRODUCTION

It is proposed that a waste fines thickener be installed at Mesa J to thicken the waste fines from the PP1/PP2 wet processing plants to 45% solids before discharge to the Waste Fines Storage Facility (WFSF). The inclusion of a thickener allows the recovery of process water directly at the process plant (from the thickener overflow) for re-use in the process. This reduces the raw water extraction requirements for wet processing and the resultant draw down levels in groundwater, which is essential for maintaining the habitat of the blind cave eel.

The thickener is a solid/liquid separation unit which creates two products, an overflow and an underflow product. Flocculant is used as a reagent in the thickening process to assist with the settling of the solids to the underflow stream. Flocculants used in iron ore processing are long-chain polymers that cause fine particles to collide and agglomerate such that they sink to the floor of the thickener, resulting in a high solids concentration underflow stream and a near solids free overflow stream (<100 ppm solids). This produces an overflow stream that is suitable for re-use in the process plant, as well as reducing the volume of slurry that is sent to the WFSF.

The proposed flocculant for use in the Mesa J process is an anionic polyacrylamide, similar to those used at all RTIO wet process plant sites. Anionic polyacrylamide has no systemic toxicity to aquatic organisms or micro-organisms. It is considered environmentally sensistive compared to alternative flocculants such as the cationic variety. Concern has been expressed regarding their impact on the groundwater should there be seepage of flocculant through the floors and walls of the WFSF. This memo aims to allay these concerns by presenting a summary of studies conducted into this phenomenon, as well as modelling of the transport of flocculant from the process plant to the WFSF to determine worst case flocculant concentrations in the seepage.

LITERATURE REVIEW OF POLYACRYMALIDE BASED FLOCCULANTS

Literature was reviewed of the impact of polyacrylamide based flocculants on water systems. Three papers on the subject were sourced:

1. Reber, AC, Khanna, SN. “Thermodynamic stability of polyacrylamide and poly(*N,N*-dimethyl acrylamide” (2007)

2. Auckland Regional Council. "Overview of the Effects of Residual Flocculants on Aquatic Receiving Environments" (2000)
3. SNF. "Floerger AN 900 Series. Anionic Polyacrylamide Environmental Impact".

Polyacrylamide itself is not a dangerous compound and if stable, will present no issues for plant or aquatic life. The concern is that the polyacrylamide will break down over time to produce an acrylamide monomer, which can be toxic. Polyacrylamide also contains residual amounts of the acylamide monomer left over from the production of the flocculant.

The study by Reber, AC, showed that under environmental conditions, polyacrilaminde flocculants do not degrade back into the acrylamide monomer. The acrylic double bond is destroyed during polymerisation and there is no plausible pathway for it to reform during biological and chemical degradation in soil.

The SNF paper outlines the maximum residual acrylamide monomer found in their flocculants. The residual concentration of acrylamide will never reach the toxicity level for aquatic species in the concentrations that RTIO intends to use the flocculants. Also, the acrylamide polymer is biodegradable, and will break down over time.

The Auckland Regional Council paper concluded that anionic polymers in comparison to other flocculants, *are recognised as the safest to use and would be the most appropriate where a particular receiving environment was regarded as a sensitive location* and that *there is no reasonable basis upon which to speculate that residual unbound flocculant is likely to cause adverse effects in the marine receiving environments*. This is supported by two major environmental assessments sited in the SNF paper, which concluded that anionic polyacrylamide does not represent a danger to the environment. STOW, the Netherlands Waste-Water Authority concluded that the use of flocculants in waste-water treatment does not consistute a risk to the natural environment. Also the Environment Agency of the United Kingdom concluded that anionic polyacrylamide is not a priority for setting of environmental quality standards and of little environmental concern.

The Auckland Regional Council paper also concluded that the flocculant will absorb onto soil. They do not leach through soils, rather they bind the soil particles together which in turn can have some positive implications by preventing the transport of other contaminants (such as pesticides and herbicides) through the soil and into the groundwater. Which supports the long held assumption that the flocculants remain with the solids within tailings dams, rather than being associated with the water and thus seepage.

MODELLING OF FLOCCULANT BUILD UP AND SEEPAGE

Modelling of a 'worst case' scenario of flocculant build up within the WFSF was performed using the Goldsim modelling package. The worst case is considered where the flocculant is 100% associated with the water in the WFSW and will not stay with the solids in the WFSF, as is anticipated. It is assumed for this modelling that seepage water will enter the surrounding aquifers at the peak concentration at which the water reaches within the dam.

This modelling was performed to demonstrate the low risk the flocculant has on the surrounding aquifers and its marine and plant life.

Modelling Inputs:

The following inputs for the thickener underflow were used in the modelling:

Parameter	Unit	Vale
Solids rate	t/h	615
Solids density to WFSF	% solids	45

Water rate	t/h	752
Total rate	t/h	1367
Flocc rate	t/h	0.06
Flocc addition rate	g/t solids	90
Flocc concentration to WFSF	ppm	41

The flocculant is added to the solids at a maximum rate of 90 grams per tonne (g/t) of waste fines before the thickener, which is then diluted considerably during the thickening and pumping process, to enter the WFSF at a concentration of 41 ppm. The Goldsim model uses this data, as well as data from the WFSF design (pond area, beach area etc.) and randomised seasonal data take from the Robe Valley region, including evaporation and rainfall data, to calculate a maximum concentration of flocculant within the WFSF.

Modelling Results:

The modelling showed that the peak concentration of flocculant in the WFSF was ~55 ppm, which equates to a maximum of 0.2 tonnes of flocculant seeping into the groundwater per day. The modelling results are shown in Figure 2.

This peak concentration sits comfortably below the 100 mg/L limit for toxicity to marine life as outlined in the flocculant MSDS. However, as the flocculant will settle with the solids and not be associated with the water as per the literature, concentrations this high within the seepage will not occur.

Conclusion:

The type of flocculant and the concentrations in which it will be used at the Robe Valley, presents a low risk to the environment and surrounding water systems.

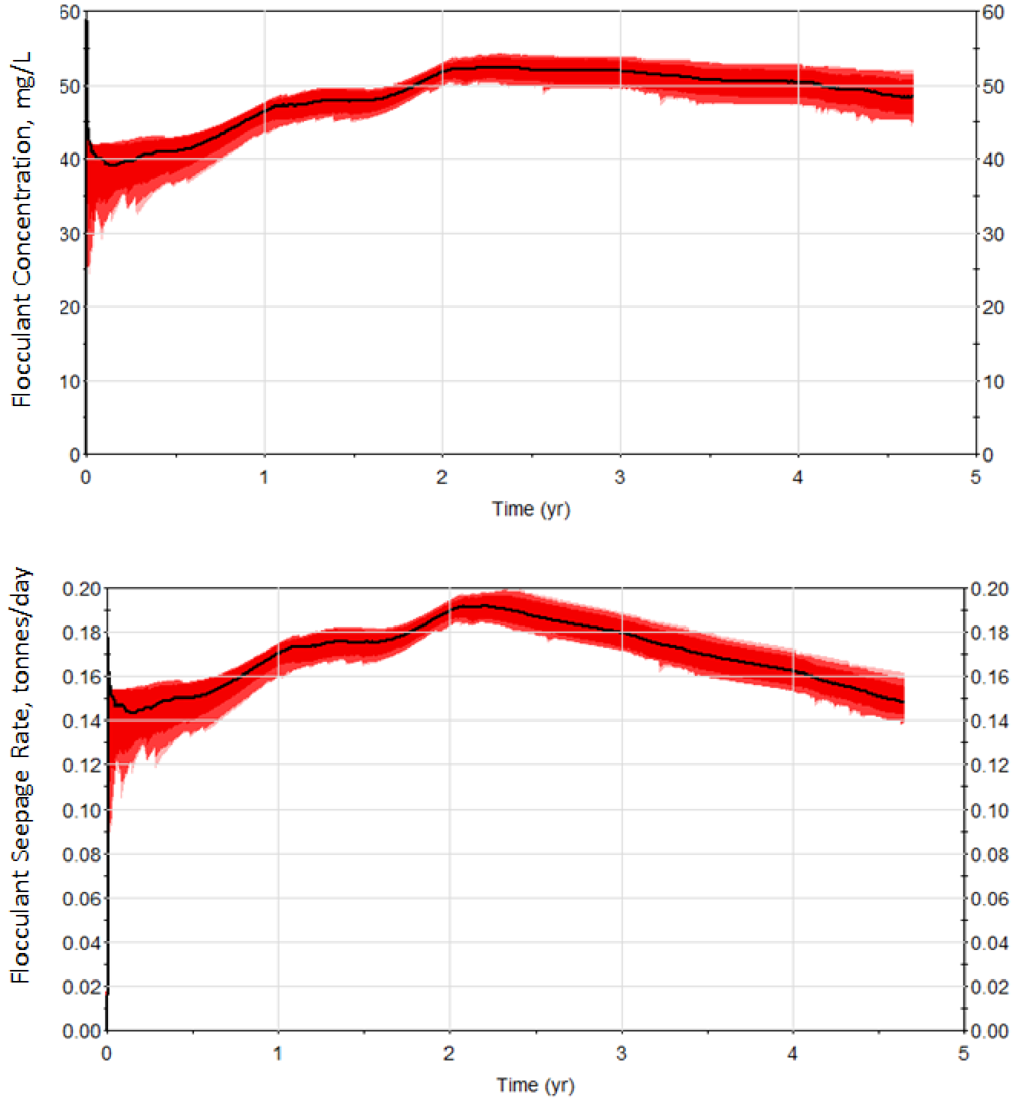

Figure 2 – Goldsim Modelling Results