Thixotropic effects on the rheology of polymer amended mature fine tailings

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Rheological properties of note in polymer amended MFT

• Viscosity bifurcation – manifested yield stress is shear and ageing dependent during flow
• When material stops flowing (or even when it is still flowing at a relatively slow speed), it rapidly increases in yield stress due to both thixotropy and consolidation
• Practically, this means that flocculated tailings can recover from over-shearing
• Ageing – thixotropy influence on long term dewatering?
Viscosity bifurcation Part I

Shearing from state of rest \( YS \sim 400 \text{ Pa} \)
Viscosity Bifurcation Part II
Manifested Yield Stress after shearing during deposition ~ 50 Pa
Are there constitutive models that describe this behaviour?

Yes, Hewitt or Coussot various papers

Model viscosity as a function of shear

And ageing
When flocs shear do they permanently shear? $G'$ measured by oscillatory rheometry
Before shear, after, after plus 45 minutes
Before shear, after, after plus 45 minutes- Image analysis of above images
Consequence for surface deposition: Large (6 m) flume tests at OSTRF
We know how to adjust mixing regime to control tailings quality: 3 versus 2 static mixers
Non-contact displacement sensors to track transient profile
First pour – “fast” (36 litres / minute)

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[Graph showing relationship between runout (m) and height (cm) for various times t: △ t=5min, × t=10min, ◇ t=15min, + t=20min, ○ t=end, X Measured]
Can be predicted with a YS close to low end YS observed in rheology

LT Prediction using 60 Pa YS

Deposited at 36 litres / min for 25 minutes
“Slow” pour – 10 litres / minute
Pictures from the slow pour

We are trying to model these tests.
Early deposition can be fitted to 400 Pa – YS corresponding from the at rest tailings
We are trying to model this – CFX and SPH...here is an SPH output- yellow are highly sheared tailings, blue tailings that recovered 400 kPa YS
Application of ageing/thixotropy to dewatering:
10 cm tall samples...pore-water pressure dissipation stops at 10 days
SEM Images from 1, 7, 21, 35 & 60-Day Samples (500X, in a Clockwise Pattern)
Acknowledgements

• OSTRF
• COSIA
• NSERC
• Shell Canada