

MARCH 31, 2004 TO APRIL 2, 2004
CAPE TOWN, SOUTH AFRICA

The annual Paste and Thickened Tailings international seminar, a continuation of a series of workshops and seminars initiated in 1999, has become the key forum for the advancement of paste and thickened tailings technology worldwide. The seminars have been held in Australia, Canada, South Africa and Chile and in 2004 the venue returned to South Africa in March. The seminar was held at the new Cape Town International Convention Centre and was organised by Professor Andy Fourie of the University of Witwatersrand and Dr Angus Paterson of Paterson & Cooke Consulting Engineers (Pty) Ltd. Apart from the three day seminar there was an optional one day workshop before the conference and a site visit after the seminar. More than 100 delegates from South and North America, Australasia, Europe, Botswana and South Africa attended the seminar, and approximately half of these attended the optional workshop and site visits as well.

The one day workshop continued the theme of the ACG First Minerals Processing and Tailings Rheology Workshop held in Melbourne, Australia in May 2003. The 2004 workshop included a brief introduction to rheology as many of the delegates had attended the Melbourne workshop, and more time was spent on pumping and pipeline issues. Special emphasis was placed on the deposition aspects of thickened tailings. During the afternoon practical session the delegates had the opportunity to perform their own deposition tests using freshly prepared thickened tailings. Professor Paul Slatter of the Flow Process Research Centre at Cape Technikon presented a comprehensive overview of rheology fundamentals, measurement problems, rheological models, rheometry and rheological characterisation, the effect of solids concentration and chemistry on rheological parameters and an

overview of time dependent behaviour. This was followed by two lectures on practical pump and pipeline issues presented by Dr Angus Paterson. Laminar and turbulent pipe flow models were discussed, together with worked examples, and the effects of viscous media on centrifugal slurry pumps was presented. The depositional aspects, presented by Professor Andy Fourie, compared the differences between conventional tailings disposal and high density paste and thickened tailings disposal. The latest research being done on predicting beach angles, and the effect of yield stress on beach angle, was discussed. After lunch the workshop moved to the recently completed slurry testing laboratories of Paterson & Cooke Consulting Engineers (Pty) Ltd where the delegates was divided into three groups. Each group was given a large sample of freshly thickened mineral tailings to use in the different demonstrations. Each sample had different solids concentration slurry. All the samples were prepared on site using an Outokumpu pilot plant thickener, installed and operated by Outokumpu personnel. The thickener, a clear Perspex unit, showed the formation of the flocculants and the formation of the settled bed and provided a clear demonstration of how a deep bed thickener works. Each group completed the following tasks or demonstrations:

- The rheology of each sample was measured using Paar Physica MC 1 viscometers, generously supplied by Advanced Laboratory Solutions for the workshop. Additional vane yield stress tests were done using a shear vane and the FL100 measurement system.
- Beaching tests were done by pumping the freshly prepared sample into Perspex flumes



Figure 1 (left): Workshop delegates discussing different beach angles in test flumes.

Figure 2 (right): Flow of freshly prepared thick tailings in a Perspex flume.



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Figure 3: Slump tests during the workshop.



at different angles. The beach angle and profile for each test was measured.

- Practical measurements of slump were done using ASTM 300 mm tall slump cones and compared to slump tests done using The University of Melbourne's "fifty cent rheometer" straight sided cylinder.
- Tube viscometer tests were done using a novel field viscometer developed by Paterson & Cooke Consulting Engineers.

At the end of workshop each group's results were compared and the effect of solids concentration on the rheology of the mineral tailings could be observed.

The seminar began the following day and the keynote address by Mr Joe McAlinden of De Beers Consolidated Mines Ltd entitled "Thickened Tailings Technology in the De Beers Group" set the scene for the remainder of the conference as it summarised the excellent work being done by the mining industry, and De Beers in particular, to minimise water consumption. The key drivers for adopting high concentration thickened tailings disposal were addressed by Professor Richard Jewell of the Australian Centre for Geomechanics, and a general debate on how convincing these drivers are was hosted by Professor Andy Fourie. The following session on rheology included papers by Dr Nigel Heywood of Aspen Technology, who discussed the importance and special considerations needed when making rheological measurements on pastes. This is an important issue as many test programmes do not address all the relevant issues. Dr Fiona Scales of

Rheological Consulting Services in Melbourne, Australia, discussed compressional rheology and its relevance in the thickening and dewatering process. Advances in thickener technology were presented by Stephen Slottee from Paste Thick Associates and the use of paste thickeners in mine paste backfill applications was presented. A fascinating case study using novel disposal methods for pyritic tailings was presented by Phil Newman of Golder Associates, UK, and this was followed by two papers on paste pumping, by Paul Geraedts of Weir-Envirotech, who focussed on special aspects for the design of paste pumps, and Dr Angus Paterson who discussed the importance of a systems approach when designing a paste disposal facility. The first day ended with an enjoyable sunset cruise in Table Bay sponsored by Weir-Envirotech. The second day of the seminar was opened with a keynote address by Professor Paul Slatter who discussed the measurement and role of rheology in paste pipelining. A fascinating paper by Andrew Vietti on the importance of chemistry in the suspension and compaction behaviour of paste was followed by a practical application by Jim Wallace from GL&V on the use of thickeners in increasing leach capacity at Murrin Murrin mine in Australia.

The remainder of the day was largely spent on case studies from various sites around the world, including Australia, South Africa and Peru. Paul Williams from Australian Tailings Consultants presented a continuation of a paper presented at the 2003 conference entitled "Delivering the Benefits (2)" that dealt with case studies from Century Zinc and Sunrise Dam gold mine. An interesting example of in-pit disposal of paste tailings was presented by Jan Hohne of Ekapa Mining that illustrated what can be achieved by a dedicated team and by pushing the envelope of process equipment. Advances in tailings management systems using internet based technology were discussed by Guillaume de Swardt of ECMP using the Kimberley Combined Treatment Plant as an example. The effect of shear on a shear sensitive thickened tailings was discussed by Bernard Krause of Ticor South Africa. The Hillendale Mine heavy minerals deposit has a high fines fraction and the mining and processing of the ore requires special consideration due to its shear sensitive nature. Two papers on flume tests, one by Adriaan Meintjies of SRK, and the



Figure 4: Workshop delegates using Paar Physica viscometers.

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other by Professor Andy Fourie, raised special interest. The interpretation of data obtained in small scale flume at low flow rates is currently the focus of several researchers and these papers presented some important results. The latest research on advances in modelling the flow of non-Newtonian fluids in open channels was presented by Dr Rainer Haldenwang. This research will become increasingly relevant as there is a greater need to transport material at higher solids concentrations. This was evident in the case study presented by Rob Williamson of Knight Piésold which summarised the results of a feasibility study for the large scale disposal of thickened copper tailings using an existing network of concrete flumes to transport the tailings from the mine site to the deposition site. The detailed geotechnical aspects of this exciting project were covered in a separate paper by Ronnie Scheurenberg. Day two ended with the seminar banquet generously sponsored by GL&V.

The final day's opening address by Hartmut Ilgner of CSIR Mining Technology was especially relevant for many deep level mines considering paste backfill as an alternative to conventional hydraulic fill. Many important issues were raised that need to be considered on a mine by mine basis. Three more papers on mine backfill illustrated varying approaches for mine backfilling that emphasised the points raised in the keynote address. Dr Robert Cooke presented aspects of the design and commissioning of the Boulby Mine backfill system in the United Kingdom. This system has several interesting features, one of which is the unique viscosity control system to monitor the flow properties of the backfill. Phil Newman summarised the design considerations for the Kidd Creek Mine D paste fill system, and Frank Palkovits of Golder

PasteTec assessed the economics of paste and hydraulic fill for backfilling using a case study. The last two sessions included several interesting case studies. Andrew Copeland from Anglo American Technical Services summarised the lessons learned from the co-thickened and cyclone disposal system for Orapa Mine. Dr Gordon McPhail from Metago Environmental Engineers, Australia, presented the background to the development and implementation of the thickened tailings disposal system at Osborne Mine in Queensland, Australia. The final case study, presented by Roger Welff of Golder Associates summarised the work done and trade-off studies for the development of a high concentration co-thickened disposal system for Venetia Mine in South Africa. A novel paper on new thickening techniques was presented by Wallie du Toit of Magra Process. This technique uses low energy vibrators on the side walls of deep cone thickeners to assist the settling and bed compaction.

After the workshop and seminar, the delegates who had enrolled for the site visit boarded the early morning charter flight the following day from Cape Town to Kimberley. The site visit to the De Beer Combined Treatment Plant thickened tailings disposal site and Ekapa Mine in-pit disposal site was a highlight for many of the delegates. It was a fitting end to an extremely informative five days.

The organisers of Paste 2004 were able to host the workshop, seminar and site visit because of the generous support of the main sponsors; Wirth, Weir-Envirotech, GL&V, and the event sponsors. To order copies of the proceedings on CD, and for further information on forthcoming Paste seminars, please contact Wanda Fouquet at wanda@pcce.co.za.



Figure 5 (left): Site visit delegates at the entrance to the historic Kimberly Club.

Figure 6 (right): In-pit disposal at the Ekapa Site.