Fine Coal Recovery from Tailings Impoundment’s.

Introduction.

This presentation will deal briefly with the construction to completion of the Minpro Wollondilly fine coal tailings recovery and treatment project at Clutha`s and later SADA`s Wollondilly CHPP site by outlining the following,

- The Resource.
- Process requirements.
- Contractual requirements.
- Construction.
- Manning.
- Resource recovery by Dredging.
- Production and product specifications.
- Reporting.
- Maintenance.
- Benefits.

From September 1992 to the completion of the project in July 1998 my role in this project was Managing Construction, Recovery and Processing on site.
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The Resource

The Wollondilly tailings impoundment was created by Clutha limited in the late 60’s to accommodate tailings disposal from the new CHPP recently constructed by the company.

As was the case with many coal operators of the time, little thought was given to the value of the fine coal escaping from the prep plant in the tailing streams. Indeed, throughout the industry worldwide, until relatively recent times, and for a variety of reasons, the efficient recovery of fine coal (-2mm) was routinely placed in the too hard basket.

The result for Wollondilly as of December 1992, was a number of tailings dams, the largest of these, constructed within a steep blind valley, had an indicated volume of 2,400,000 cubic meters of tailing material contained by a chitter wall of uphill construction.

A very real problem Minpro faced when originally looking at the deposit was the lack of accurate surveys, or indeed any real history from the plant regarding the construction of the dam, deposition points, tailings analysis, chitter dumping etc. There was however sufficient information available regarding volume of the dam for the company to take the next step and begin test-work.

Sampling of the resource was performed by Minpro using a proprietary technique refined by the company. This technique allows for an accurate core sample of 6+mtrs in depth to be extracted from fine tailing deposits of high moisture content in areas that are not accessible to heavy mobile machinery.

The results indicated that the deposit was amenable to a spiral gravity plant design (later augmented by the addition of flotation).
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Process Requirements.

The original process for the Wollondilly plant was designed for the recovery of + .125mm coal at <12% ash.
This involved
1. Dredge reclaiming and slurry transportation.
2. Screen sizing to -2mm.
3. Primary desliming.
6. Tailings disposal
7. Product thickening and desliming.
8. Centrifugal dewatering and desliming.
Later requirements were
10. Water recovery via thickener.
11. Treatment of -125mm by flotation.
12. Flotation product dewatering.
The process had to produce a stand-alone product that could easily be handled and transported by truck. The challenge for the company was to consistently produce a product that could be transported in trucks and off loaded without incident. To achieve this, the process had to achieve near perfect slime removal.
The process also had to produce a product that would meet the specifications required by the client (Clutha Limited and later SADA limited). Clutha and later SADA wished to use this product as an ash sweetener in some shipments and also to sell into coking coal blends.
The process was to maintain a nominal input of 100tph and achieve a recovery of 28% @ 12% ash and 8% moisture.
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**Process Requirements** Cont’

Investigation of other process methods were considered with onsite test work of a Teetered Bed Separator performed by Dr Stuart Nicoll, and the construction of a small operating Oil agglomeration plant of Minpro design, again with assistance from Dr Nicoll and also the staff of TUNRA at the University of Newcastle. Full-scale commercial operation of the TBS or the Agglomeration plant unfortunately did not occur at the Wollondilly plant, although it should be noted that results from the agglomeration pilot plant have shown that agglomeration on a commercial scale can be viable.
Contractual Requirements.

The contract required Minpro to design and build a plant that had a capacity to produce a product ash in the range of 8-10% ash. Target ash of the product was to be 10% unless otherwise notified by the Clutha general manager of Marketing or his nominee.

Moisture: When the total moisture as tested at Clutha`s Narellan laboratory, discloses a product moisture on a daily basis in excess of 8% then the daily tonnage recorded shall be adjusted to 8% with fractions pro rata.

Ash: When the ash of the product discloses a product ash on a daily basis between 8% to 12% then an applicable rate paid for the coal was as per a price scale.

Tonnage: The plant was to deliver up to XXX tonnes per annum.
Construction.

The company made a decision to use in house personnel for the design and employees from the previous Glenlee operation for the majority of the construction of the Wollondilly project.

The benefits here were two fold,

1. The cost benefit of utilizing an existing experienced workforce.
2. The construction workforce consisted of plant and dredge operators and plant maintenance people from the previous Glenlee project, this meant that people constructing the plant already had an intimate knowledge of the systems being built. A great benefit here is that shortcomings in the plant design (from an operational point of view), were being rectified during construction by the very people that had identified the problems in the first place, and would eventually operate them again.

The plant, totally enclosed within a metal lined building, was of semi modular construction so that sections or modules of the plant could be taken off line or brought into service during production depending on quality requirements or maintenance.

All pipework within the plant was HDPE utilising victaulic and flange end fittings, this allowed all process pipework within the plant to be replaced when necessarily by 1 or 2 non tradesmen quickly and easily with minimal tools.

Project management was split two ways
1. On site construction management.
2. Off site engineering, procurement, and expediting

Starting from bare ground with no water and only generator power, the following

Civils.
Washery building.
Processing plant
High and Low voltage systems.
MCC and Plant PLC installation.
Remote processes water-pumping station and associated delivery lines.
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**Construction Cont’**

Dredge installation, delivery lines and remote booster pump.  
Tailings disposal systems.  
Offices and bathhouse.  
Pole mounted Pit lighting system.  
Were constructed and production under way 7 weeks and 4 days from start date.

Later additions to the plant were the installation of a
- Warman thickener
- Jameson Cell flotation plant.
- Screen Bowl Centrifuge.
Manning

The Wollondilly project initially started as a 5 day 24 hour operation with 8 men not including myself, and finished as a 5.33 day 24 hour operation with 12 men not including myself.

Initially on each of three shifts were one Dredge operator and one Washplant operator, these men worked rotating shifts and a 5 day week. The Day shift had a permanent leading hand-supervisor and a fitter welder.

However, with the distance between the dredge and the plant increasing in excess of three hundred meters and at times not in direct line of sight, it was deemed necessary from a safety point of view to have an extra man on each of the back shifts.

Over the life of the project a number of different shift rosters were tried, from 5 day 3 shift 8 hours to 7 day 3 shift 12 hours.

All employees were members of the UMFA and came under the same classification and received the same rate of pay.

No time was ever lost through industrial action brought on by the employees.
**Resource recovery by Dredging.**

Dredging, as a means of mining or reclaiming is not a new process, for many years it has been used to recover a wide variety of minerals. The recovery of fine coal tailings by dredge however is not all that common.

The dredge used at Wollondilly was a Jaden Platypus series; electric hydraulic unit supporting a Warman 8"6 EG gravel pump. Power was supplied from an on shore transformer by cable supported by the delivery line drum floats. Maximum cutter suction depth was 6.5mtrs.

Positioning of the dredge was by the standard 3-wire system (two forwards and one tail).

A number of dredge cutter assemblies of Minpro design were utilised depending on the composition of the tailings at various levels in the pit.

The recovery rate was a nominal 100tph at a flow rate of 110 lps, delivered to the plant via 1 booster pump station through a 200mm HDPE pipeline (later increased to 225mm).

There were several obstacles to be overcome dredging the coal tailings at Wollondilly.

1. Size distribution and composition of material within the pit. At times the dredge would encounter block slime material (-100microm) and at other times be faced with coarse rock and chitter (top size 200mm). The dredge mined 197,559 tons +2mm -200mm material and 2,541,458 tons -2mm in 6 years.

2. Trees. The valley the pit was constructed in unfortunately was not logged out prior to being filled with tailings.

3. Water. Maintaining a static water level within the pit while delivering a constant 110lps from the dredge.

4. Pipeline and trailing cable maintenance. All pipeline (200mtrs on water) repair and changing had to be accomplished by hand, as vehicular access within the pit was impossible.

To detail the difficulties overcome with dredging the Wollondilly project would require far more time than available here, suffice to say they were overcome and the dredge maintained an average feed to the plant of 98tph with above 85% availability over the life of the project.
**Reporting.**

Initially, all project reporting and clerical work (payroll, coal invoicing, ordering and procurement) was shared between site and company offices in Sydney, the Wollondilly project however was gradually redesigned to be a stand-alone operation that would require virtually no clerical staff at all. All ordering, consumables tracking, coal invoicing, payroll, production and quality recording (project start to date by hour, shift, day, week, month, quarter and year) were to be handled by the site manager. This was achieved by the use of a computer program developed in house by Minpro`s quality manager.

The program was designed to be both user friendly and comprehensive, combining a simply maintained data base with modern communication systems. Quality (ash and moisture) testing was outsourced and the results were supplied daily. These results were entered into the plant computer along with daily production figures from the shift logbooks, to give an archival database. All reports normally (including invoices, downtime analysis, daily and weekly production reports, production bonuses....) were produced automatically by this program and published by print, fax and/or Internet. In addition, the data was available to the user to create other reports, charts and analysis as an excel spreadsheet.

A parallel-ordering program, linked to the plant equipment database provides a close but simple control of maintenance costs. Purchase orders and reports are published by print, fax, and Internet.
Maintenance.

With an operation such as Wollondilly a flexible maintenance system was required that allowed plant overhaul to be based on operator judgement as opposed to time or tonnage. This ensured that no equipment was ever needlessly replaced or expensive maintenance time wasted in areas that did not require it.

This approach did however require a level of commitment from the plant operating staff, to get this commitment the men were given a degree of ownership of the plant maintenance, once the workforce became aware that management would act on their recommendations I found the results amazing. Without going into great detail the result was a wash-plant availability of 94+% calculated over 6 years.

Replacement parts where ever possible were of Original Equipment Manufacture, this did increase costs in the short term although over the project life substantial cost reduction and increased plant availability was achieved. The usually higher OEM costs were more than offset by longer overhaul periods, and gaining access to the OEM's engineering and support services saved bucket loads of cash on more than one occasion.

Routine maintenance of specific areas of the plant was assigned to individual personnel rather than specific shifts, an example being that the same man always greased conveyors, or checked oil levels etc, etc. The result was that ownership and responsibility of these areas passed on to individuals who over time gained an intimate knowledge and background of their area of responsibility.

A good check on maintenance was the plant statutory inspections, each piece of equipment requiring a 103 had a manually generated inspection report that was duly performed at the required time, these checks rarely picked up faults the operators hadn't already reported.

The ability to keep the informal maintenance scheme effective was made possible by the efforts of a dedicated workforce, the advice and help offered by suppliers such as
Warman,
Imdex,
Tema,
Jaden, to name a few, and the excellent performance and ability of my 2IC, Craig Morley to always get the job done.
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Benefits.

In recent years the coal industry has been forced to accept greater responsibility to reclaim lands disturbed by mining activities. Legislation reflecting public concerns regarding environmental and energy conservation issues has led to detailed regulation and staunch oversight by Federal/State enforcement agencies. The coal mining industry recognises that this regulatory compliance in today’s competitive market requires developing more cost-effective responses to the issues of coal refuse and reclamation methods. The Wollondilly tailings reclamation project provided a proven alternative to these issues with its demonstrated expertise in fine coal refuse recovery, and treatment and reclamation expertise.

Coal companies seeking a low-cost alternative to traditional reclamation techniques provide a growing demand for Minpro Wollondilly reprocessing operations. This type of process can add value to the sale of mine properties by conversion of the reclamation liabilities to a resource.

Another avenue for consideration is the ability of this process to attach itself to existing plant tailing streams, relieving the coal companies of the high capital and running costs of plant upgrades.

At the conclusion of this presentation I would like to thank Mr Gary Purdon, General Manager Minpro/Deepgreen Minerals and Mr Douglas Caddy, Quality systems Manager Minpro/Deepgreen Minerals for their assistance.
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Afterword.