

This note describes the application of the *FluidFlow3* software package to the design and simulation of all types of mine pumping systems including:

- Mine dewatering using submersible and end-suction centrifugal pumps.
- Bore farms using borehole pumps.
- Process flows using end-suction centrifugal and positive displacement pumps.
- Spray/sprinkler systems such as dust suppression and fixed fire protection.
- Potable water.
- Instrument and process air.
- Simulation of the performance of control valves, heat exchangers, orifice plates and almost any type of line equipment.
- Slurry Flow

FluidFlow3 is a Windows-based software package for the simulation of flows through complex pipe systems. The program calculates flows and pressures throughout the pipe network as well as the performance characteristics of pumps, control valves and other line equipment. *FluidFlow3* is extremely easy to use and has a range of powerful features including: -

- An advanced graphical user interface allowing almost intuitive interaction with even the most complex models.
- A highly effective data management system comprising user-definable equipment and fluid properties databases.

FluidFlow3 can simulate the performance of multiple pumps in series, parallel or booster configuration. It is ideal for the investigation of existing systems prior to upgrade or extension and the design of new systems.

FluidFlow3 can simulate the flows of non-Newtonian/Non-settling liquids and settling slurries.

FluidFlow3 has applications at all stages of a mining project, viz:

Conceptual Stage: At this early stage estimates of pipe sizes and pumps are required. Possibly at this time equipment items on long lead-times need to be ordered. Using *FluidFlow3*'s flowsheet representation of the pipe network, outline systems can be quickly developed with sufficient accuracy to make these types of decisions.

Design Stage: This is where the software would be used for the detailed design of the flow system - economically sizing pipes and control equipment, performing "what-if?" case studies, determining the performance of the system as pipes foul up over time. Precise modelling at this stage allows all associated design and equipment sizing to be performed accurately, viz electrical supply systems, control valves, etc.

Commissioning Stage: The actual performance of the system is compared to model results. De-bottlenecking occurs here.

Operation Stage: The pipe system model remains a valuable engineering resource as the project matures over time. It can be used for "tweaking" the system, or designing upgrades and improvements.

GENERAL PUMPING DESIGN

A typical mine dewatering system may involve multiple pumps, say submersible dewatering pumps supplying direct to tanks. For the processing plant the system may be a cooling water circuit supplying multiple facilities or the internal process flows within the facilities.

FluidFlow3 allows users to create a database of pump curves saving the following data:

- Pump name, model etc
- Capacity curve
- Efficiency curve
- NPSH curve
- Operating speed and impeller diameter
- Maximum and minimum speed and impeller diameter
- Maximum and minimum flow

Once the system model has been developed and the pump or pumps selected, the program will calculate flows and pressures throughout the system. The following can be performed:

- Pumps can be switched on and off.
- Pump speed and impeller diameter can be changed within the model and the affinity laws applied to the entered pump curve.
- The Hydraulics Institute correction for viscous fluids in end-suction centrifugal pumps can be applied.

After calculation the software may generate the following warnings:

- Inadequate NPSH.
- Pump(s) operating outside set limits of minimum and maximum flow.
- Negative pressures or vapourisation of flow in the pipe system.

Full user-definable reports can be generated or results can be exported to Excel.

BORE FARMS

FluidFlow3 is ideal for the design, analysis and on-going monitoring of the performance of a borefarm.

The software allows the simulation of multiple bore pumps with pumps turned on/off to replicate operational conditions. Once the model has been constructed, it is simple to perform “what if?” calculations. Bore levels can be changed, different types of pipe and size investigated. *FluidFlow3*'s visual display of results and especially the instant display of pump curves and duty points provide the engineer with a ‘snap shot’ of how the system will perform under specified conditions.

PROCESS FLOWS

FluidFlow3 allows for the determination of heat change in fluid flow systems, viz heat loss/gain through pipes walls (lagged or unlagged), heat change at equipment items such as heat exchangers. Consequently, process flow systems involving heat exchanges can be simulated.

Other parts of the process system modelled by *FluidFlow3* are instrument and process air supply and steam flow.

SLURRY FLOWS

The *FluidFlow3* Slurry Module is divided into two parts: **non-Newtonian/non-settling liquids** and **settling slurries**.

Non-Newtonian/non-settling liquids can be simulated using four different correlations, viz:

- Bingham plastic
- Power law
- Herschel-Bulkley
- Casson

Settling slurries can be simulated using one of three different simulations:

- Durand
- WASP
- Wilson-Addie-Selgren-Clift

For more information on slurry flow see *Application Note 11*.

COST BENEFIT

In all fluid flow systems there are penalty costs arising from both over- and under-sizing the system. *FluidFlow3* allows for the accurate sizing of equipment but also for appropriate stress-testing of the system. Performing “what-if” calculations brings justification to factors of safety built into the design and allowances for future expansion.

TYPICAL MINING PROJECTS

Accutech has used *Piping Systems FluidFlow* (the predecessor *FluidFlow3*) and/or *FluidFlow3* for the following mine-related pumping projects:

Ulan Coal Mines: Simulation of multiple Pleuger pumps dewatering the decline by pumping vertically through boreholes to a discharge main on the surface and onwards to dams.

Springvale Coal: Simulation of large numbers of air operated and traditional end-suction centrifugal pumps for dewatering by pumping along the decline to the surface. Simulation of mine compressed air supply.

Mount Whaleback Mine: Simulation of multiple borehole and end-suction centrifugal pumps for the dewatering of the open cut.

Spinifex Ridge: Water supply including simulation of large bore farms.

MINERS AND MINING CONSULTANTS USING FLUIDFLOW3

Aker Solutions	Hatch
Ausenco	Lycopodium
Bateman Engineering	Parsons Brinckerhoff
Bechtel	Promet Engineers
Bilfinger Berger	Proteus Engineers
BHP	Queensland Alumina
Bilfinger Berger Services	Rio Tinto
Calibre Projects	SKM
Clough Projects	SNC Lavalin
Como Engineers	Worley Parsons
Connell Wagner	Xstrata Technology
Downer EDI Mining	Xstrata Copper Australia
GRD Minproc	Zinifex Century Zinc Mine

ACCUTECH 2000 PTY LTD

Accutech is based in Perth, Western Australia and has been marketing and supporting fluid flow software for over 20 years. We also perform pumping design using our software and have conducted literally hundreds of designs of pumping and pipe flow systems.

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