Pumping oil safer thanks to new Napier donkey pump

by Michael Otto

A New Zealand company has designed a way to improve oilwell performance by keeping pumps running efficiently and providing early warnings of potential gas explosions.

PDL Electronics Ltd of Napier is implementing the techniques in a donkey pump system in China.

Donkey pumps, mechanically designed to pump viscous fluids like oil using long, slow, powerful up-and-down strokes, are used in many oil fields around the world.

PDL's motor controllers can be programmed to make use of electrical information from the pump's motor to detect a gas pocket. The motor speed can then be adjusted to reduce the risk of explosions.

"With something like oil, you can get gases that really expand quickly while you are pumping – and you don't want an explosion coming up at you through your pipe," says Marc Marchal, the company's commercial engineering manager.

A gas pocket can be detected when a drop-off in motor torque is observed, he says.

Torque can be estimated from motor current, voltage and frequency measurements made by the motor controller.

When torque drops quickly, it means the system is pumping gas rather than oil so an emergency shutdown can be done, Mr Marchal.

A slower drop-off in torque means there is some gas in the oil so the pump speed is reduced to keep the oil flowing properly and to stop gas pockets forming.

Providing protection like this requires a fast acting control system, something PDL's VYSTA software is well suited to, says Mr Marchal.

VYSTA permits motor currents and voltages to be quickly available to control systems other than the very fastest ones inside the controller.

OIL WELL: A Kiwi electronics company is making it easier to detect gas pockets, reducing the risk of oil explosions around the world.

This is because these other control systems can be programmed to exist in the motor controller itself by VYSTA rather than in slow external hardware that needs extra wiring.

Most motor controllers have fixed control programmes, so having the flexibility of VYSTA means control can be adapted for many different industrial situations, he says.

VYSTA offers over 200 different types of control block options from which to construct control systems. These blocks can be used repeatedly.

This also helps free up space on any connected communication network, since more control is internal to the controller.

"You can put the control logic where it really belongs with VYSTA."

Nigel Smith, senior applications engineer at PDL, says having a flexible control platform like VYSTA also helps donkey pumps operate at optimum efficiency throughout all of their working lives.

"You can put the control logic where it really belongs with VYSTA."

"A donkey pump is designed to operate most efficiently at a given flow rate.

"But as well conditions deteriorate with time, so does the pump's efficiency.

"By detecting motor torque levels we can use VYSTA to tell the motor to slow down over time, which helps improve its efficiency.

"This helps prolong the life of the system."

PDL motor controllers have also been used in donkey pump applications in Canada and Argentina, says Mr Marchal.

Other pumping applications where VYSTA has been successfully used as a platform for custom-designed control include lead pump systems, which are used for irrigation schemes, and booster pump systems, which are used in high-rise buildings.

"In a lead pump system, instead of operating one large pump at poor efficiency for widely varying flow rates, you can use several smaller pumps and switch them in and out using a VYSTA program as load requires," says Mr Smith.

"They can then operate closer to their most efficient point."

The control system is within the motor controller that runs the lead pump, not in external hardware, thereby saving space and cost, Mr Smith says.

Mr Marchal says booster pumps are used to maintain pressure in high-rise buildings.

"If you didn't have a booster pump then you would need massive pressure at the bottom of the high-rise to get any pressure at the top."

A VYSTA program enables the booster pump to regulate water pressure halfway up a building so that it can be maintained right up to the top floors, he says.

Mr Smith says PDL runs several VYSTA training courses each year.

The courses are aimed at upskilling systems integrators and distributors both in New Zealand and overseas.

However, PDL's own applications department custom-design 80% of VYSTA systems for local and overseas clients.

Cleaner, safer welding technique to benefit wine and dairy industries

by Sara Williams

New Zealand boat-builders and wine-makers could benefit from a new technology being researched by Auckland University of Technology staff.

Friction stir welding, a process first developed 10 years ago by United Kingdom-based The Welding Institute (TWI), is being studied by AUT engineers in the hope it will be of use first to boat builders and later engineers in the dairy and wine industries.

In the process metal is plasticised, rather than melted, unlike traditional welding where the metal is melted first.

When metal is melted for welding it becomes distorted. This does not occur when friction stir welding is used.

Senior lecturer in AUT's mechanical and production engineering department Dr Zhan Chen says friction stir welding is far better than the conventional fusion method.

"When using friction stir welding there is no spark, no fumes and no hot cracking."

Dr Chen and his colleagues are working to develop their understandings of the technology and are hoping to transfer their knowledge to New Zealand boat builders.

Robert Brooke, general manager of the Boat Building Industry Training Organisation, says friction stir welding would be great for the industry as the welding method helps keep plates straight.

"The heat generated by the traditional welding method makes plates change shape. Friction stir welding doesn't distort the metal and is more user-friendly."

TWI says that on its friction stir welding website a cylindrical, shouldered tool with a profiled probe is rotated and slowly plunged into the joint line between two pieces of sheet or plate material, which are butted together.

Frictional heat is generated between the welding tool and the work piece, which is softened by the heat, and the tool can traverse along the weld line.

"It started off as a real backyard Kiwi project, a real number eight wire sort of thing."

Mr Brooke says only two boat building companies have shown interest in the method so far—possibly because the tools needed for friction stir welding are expensive.

"Friction stir welding is mainly being used for big companies overseas," Mr Brooke says.

Despite the lack of interest or knowledge, Mr Brooke's organisation would continue to work alongside AUT in developing the process in New Zealand for local and international markets.

Ray Thompson, a senior welding lecturer at AUT, said companies in Finland have friction stir welding in production and are churning out boats.

Friction stir welding is frequently used overseas to make frames for large structures, such as space shuttles and Japan's shinkansen bullet train.

"The process means outside frames are not needed any more, which means structures are lighter and use less energy," says Dr Chen.

"Due to friction stir welding small passenger planes can be produced a lot cheaper."

Production rates are lower when the traditional method of welding is used because the welder needs to take more care not to distort the metal when it is in the liquid stage.

However, when friction stir welding is used production rates are increased, making it more cost-effective, says Dr Chen.

Richard Maginness, a Bachelor of Mechanical Engineering student at AUT, has undertaken research into friction stir welding as an industrial project for his course.

He said using friction stir welding can mean aluminum alloys that were previously unweldable can now be welded together.

The next step in the development of the process would be investigating the tools needed to use friction stir welding on steel.

Researchers are unsure what material would be strong enough to be used on steel for the rotating tool that makes the weld.

Dr Chen said if the process could be developed for steel materials, many industries in New Zealand would benefit.

"The steel vats used by wine makers would be easier to make, and cheaper, if friction stir welding could be used for steel."

TWI has placed a patent on friction stir welding, which is the only problem facing Dr Chen's team.

Discussions are underway with the institute to make friction stir welding more accessible to boat builders.

Dr Chen's interest in friction stir welding began last year when he visited Akita University in Japan, where research into the process has been going on for a few years.

Ross Reichardt, a senior technician in AUT's mechanical and production engineering department, said friction stir welding could benefit engineering in general.

"It started off as a real backyard Kiwi project, a real number eight wire sort of thing."

Mussel waste made useful

by Rebecca Milne

An AUT student is helping clean up New Zealand by investigating possible reuses for waste produced by the country's mussel industry.

Claire Barnaby (23), a marine ecology student, is doing her masters degree research on marine mussels and what systems she can develop to decrease wastage.

Miss Barnaby became interested in science during high school. She pursued her passion at Waikato Polytechnic completing a National Diploma in Science before moving to Auckland.

"I knew I wanted to do environmental science," she says.

There are fourteen other marine ecology students working on everything from mangrove ecology and biodiversity of rock reefs to plankton and squid.

Miss Barnaby's research ideas are unique according to industry standards because not a lot of published research has been done about mussels and possible reuses.

One of Miss Barnaby's research ideas is to use the shells from mussels as substitute concrete for aggregate.

Miss Barnaby produced a block of concrete with mussel shells as the filler and, after compressive strength tests, found the concrete was not strong enough.

"My results thus far suggest it's not going to be any good as an aggregate. However it could have the potential to be used on shell pathways to beaches as a filler or in the likes of insulation blocks for buildings," she says.

Miss Barnaby is also researching whether mussel waste can be used as a fertiliser for plants.

For confidentiality reasons Miss Barnaby could not divulge names of the participating mussel factories, but says at present, in the Nelson/Marlborough area, bins are being filled with decaying mussel waste, which is breaking down and turning into compost, releasing nutrients.

The decaying mussels will then have to be investigated to establish nitrogen-phosphorus and potassium levels.

Tomato plants are germinating, waiting to be fed different concentrates of the mussel fertiliser within the walls of AUT's Wellesley campus marine ecology office attic.

Miss Barnaby says: "I can compare it to a generic fertiliser and then I'll dilute it down and feed the plants once a week."

She hopes to discover whether the fertiliser improves plant growth or increases nutrient levels.

PHOTO: REBECCA MILNE

FISHY BUSINESS: AUT marine ecology student, Claire Barnaby finds ways to use mussel waste.