

Gas and Chemical Process Safety Unit

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WELDING OF POLYETHYLENE PIPES

A European 'Craft' research project managed by TWI, 'WINDEPP', has recently been completed. It studied the combined welding and non destructive testing (NDT) of polyethylene piping.

Polyethylene piping is used extensively in the gas industry as a replacement for metallic pipes in medium and low pressure service. It is also widely used throughout the chemical industry. Weld failures have been a common occurrence and this research project was focussed on a system of work that would greatly enhance the confidence in the completed piping system.

Polyethylene pipes are welded together using a heated plate which softens the polythene on each of the prepared faces of the pipe. The technique is known as 'Butt Fusion Welding' and the following procedure is adopted;

- Carefully trim the pipe faces to ensure full contact.
- Position the pipe ends close together.
- Place a hot plate between the two pipe faces.
- Heat the pipe faces for a set time.
- Remove the hot plate.
- Quickly force the pipe faces together.
- Hold the pipe faces together for a set period at a controlled pressure.
- Remove excess weld material (the weld bead) with a sharp knife.
- Visually examine the weld.

Any contamination in the weld zone can lead to premature pipe failure. Visual examination and a bend back test of the removed weld bead will detect gross dust contamination or a cold weld but will not give any information on possible buried defects such as lack of fusion or large inclusions. Failures can come from many different sources. For example :

- Poor set up of the faces.
- Air borne dust.
- Dirt from the pipe trench.
- Grease from the operators fingers.
- Incorrect hot plate temperature.
- Incorrect pressure.
- Incorrect heating or holding times.

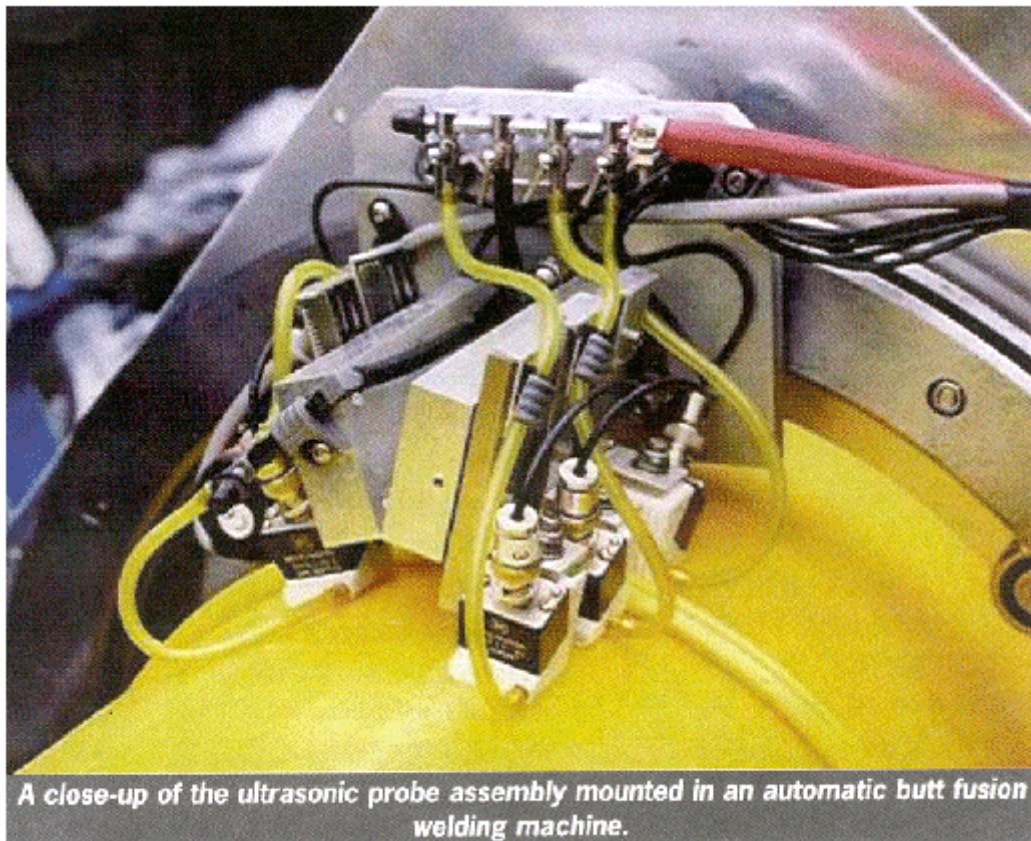
In conventional polyethylene pipe welding, all of these potential defects are left to operator skill and the process procedure to ensure the integrity of the weld as only limited NDT is possible with very low probabilities of detection.

The objective of the project was the production of a machine that welds pipes together and then scans the joint for defects as the pipe cools. The philosophy behind the approach is the use of an automated weld procedure that removes human failures by controlling preparation, heat, time and pressure. It then uses three different types of automated ultrasonic scanning to check that the weld procedure has worked correctly. Any weld that fails this scanning is automatically rejected.

Currently the machine has been used only on polyethylene piping of outside diameters in the range 125 mm to 315 mm and has been shown to be capable of detecting defects down to 1 mm diameter, sand particles and lack of fusion. Although it will not detect cold welds or fine dust contamination directly, these defects can be effectively eliminated by using the automated welding procedure. The project recommended the weld bead removal and a bend back test as the best methods of detecting cold welds and fine dust contamination.

The project was supported by the leading European gas supply companies, including Advantica Technologies. The full report is not available for distribution due to the nature of Craft projects but additional information can be obtained from Graeme Hughes in TD5.

The project managers, TWI, are confident that this technology can be easily transferred to other types of plastic pipes and other size ranges.



A close-up of the ultrasonic probe assembly mounted in an automatic butt fusion welding machine.