Development of Smart Electrofusion Fittings for HDPE Pipe

By PPN Editor

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Electrofusion (EF) fittings or couplers have long been a staple in the realm of joining High-Density Polyethylene (HDPE) pipes, offering a reliable and efficient method for creating strong, leak-proof connections. However, with the advent of new technologies, manufacturers are now pushing the boundaries of innovation by developing smart EF fittings equipped with advanced sensing and reporting capabilities.

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This article delves into some research and development that major EF manufacturers are undertaking to produce the next generation of EF fittings.

EF coupler fittings already have electrical contacts so incorporation of electronics into the fitting is easily done.

Traditionally EF fittings have two pins that pop out when the correct fusion pressure is achieved hence signalling a completed weld. These pin type indicators are very simple and do not always work as intended.

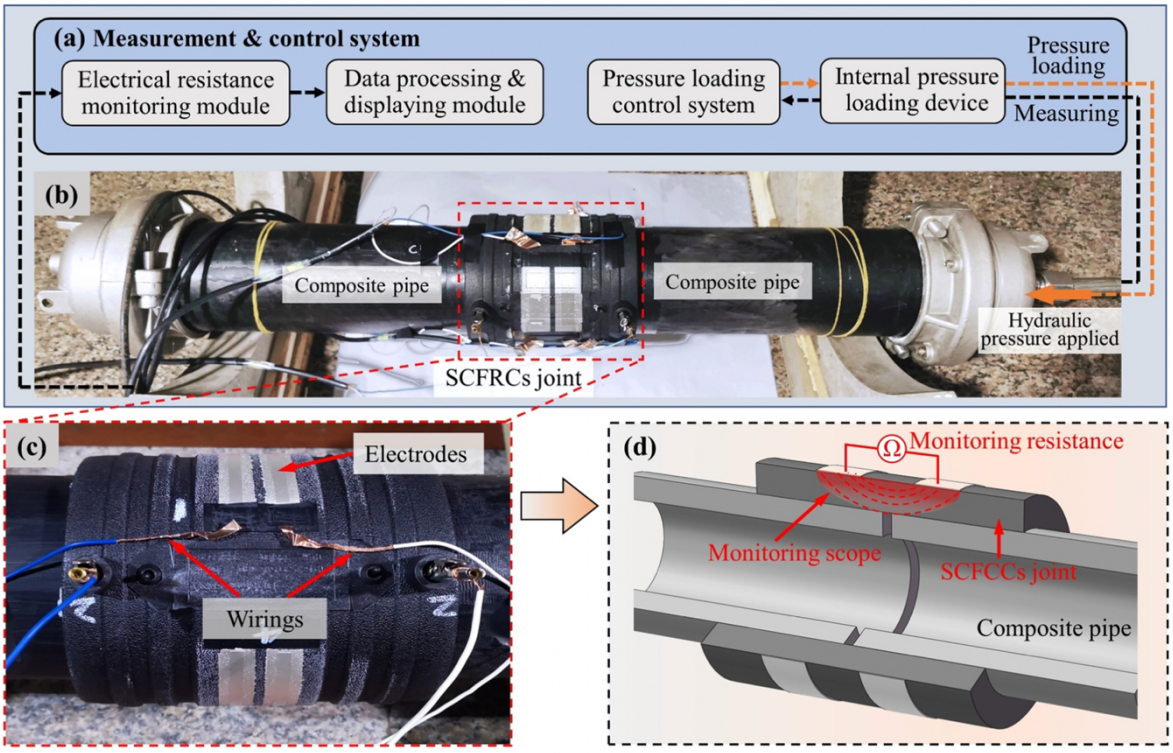
Next generation EF couplers may have LED light strips showing the degree of welding. They also contain internal sensors to ensure correct assembly and alignment of the pipe with the fitting. This is critical as misalignment stress can result in electrofusion heating wires moving out of place during the welding cycle, resulting in overheating and uncontrolled melt flow at the joint inner or outer cold zone.

Some new EF fittings under development also have internal infra-red sensors to detect carbonyl products which are a signature of the presence of an oxidized layer. In order to achieve an acceptable weld, the oxidised surface of the pipe must first be removed, to expose clean virgin material beneath the surface. If surface oxidation is detected by the fitting it will report it to the Electrofusion Control Unit (ECU) and that will signal to the operator that removal of this oxidised surface layer be done with a mechanical peeling tool.

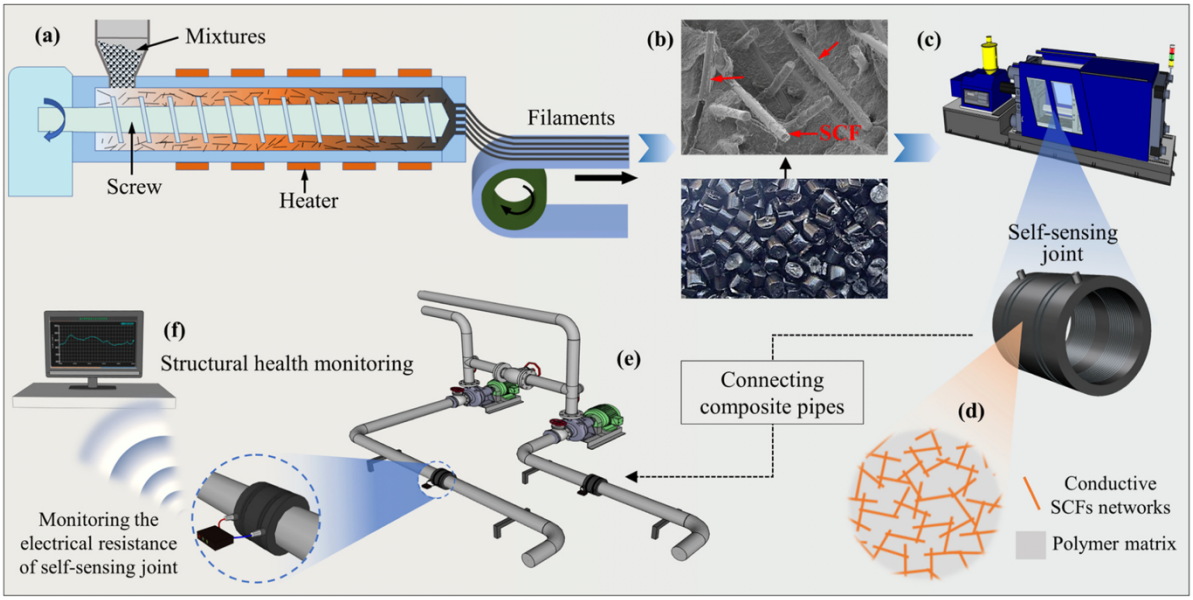
Surface oxidation acts as a physical barrier, inhibiting heat fusion, therefore consistent peeling to the correct depth is critical to the success of the welding process, and the only effective means of achieving this is use of a mechanical or rotational peeling tool.

These new generation EF fittings are designed to reduce human error problems since the effectiveness of current EF jointing depends on attention to preparation of the jointing surfaces and the geometry of the assembly, in particular the removal of the oxidised surface of the pipe over the socket depth or saddle mounting area, ensuring the jointing surfaces are clean and free from contamination, and the assembly and alignment instructions are correctly followed.

Other smart EF fittings have the ability to measure and report strain on the joint for structural health monitoring of the pipework as shown in the figure below.



These smart strain-sensing EF fitting are made from HDPE compounded with Short Carbon Fibres (SCF) as shown in the process below. The network of interpenetrating carbon fibres can sense strain via a resistance measurement.



Conclusions

One of the key advancements in smart EF fittings is the incorporation of electronic components directly into the fitting. With electrical contacts already present in EF coupler fittings, integrating electronics becomes a seamless process. These electronics enable the fitting to monitor crucial parameters such as temperature and dwell time during the welding process, ensuring optimal fusion conditions are achieved.

A notable improvement in the new EF fittings is the introduction of LED light strips to provide real-time feedback on the degree of welding. This visual indication allows operators to assess the quality of the joint quickly and accurately. Additionally, internal sensors are integrated into the fittings to verify proper assembly and alignment of the pipe, mitigating the risk of misalignment-induced stress that can compromise weld integrity.

Moreover, smart EF fittings are equipped with infrared sensors capable of detecting carbonyl products, which indicate the presence of an oxidized layer on the pipe surface. Surface oxidation poses a significant challenge to the welding process as it inhibits heat fusion, leading to weak joints and potential leaks. Upon detecting oxidation, the fitting communicates with the Electrofusion Control Unit (ECU) to alert the operator to remove the oxidized layer using a mechanical peeling tool. This proactive approach ensures that only clean, virgin material is fused, thereby improving joint strength and reliability.

The introduction of smart technology in EF fittings marks a significant advancement in the field of HDPE pipe joining. By reducing reliance on manual inspection and intervention, these fittings minimize the risk of human error and enhance the consistency and quality of welded joints. Furthermore, they streamline the welding process, saving time and labour costs while improving overall system performance by sensing strain in service.

In conclusion, the development of smart electrofusion fittings represents a promising step forward in the evolution of HDPE pipe joining technology. With their advanced sensing and reporting capabilities, these fittings offer improved accuracy, reliability, and efficiency, paving the way for safer and more robust pipeline installations in various applications.