

# Mysterious Electrofusion and Butt Fusion Failures: A New Culprit Identified

By PPN Editor  
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Recent years have seen a perplexing increase in electrofusion (EF) coupler and butt fusion pipe failures, leaving the industry searching for answers. A closer look at these failures has revealed an unexpected source: migratory contaminants on the pipe surface.

## *Inconsistent Failure Patterns*

Intriguingly, the EF failures were not systemic. Typically, only one or two out of five peel decohesion weld specimens would fail, while others passed. This inconsistency pointed to a localized issue rather than a widespread manufacturing defect.

## *The Role of Peeling Depth*

Researchers have discovered that peeling to a greater depth often resulted in EF welds that did not fail. This finding suggested that the problem lay in the surface layer of the pipes.

## *Identifying the Culprit*

Investigations have confirmed that the migratory species responsible for these failures are fluorinated oligomers. Further analysis attributed these C-F species to fragments of fluorinated polymer processing aids (PPAs).

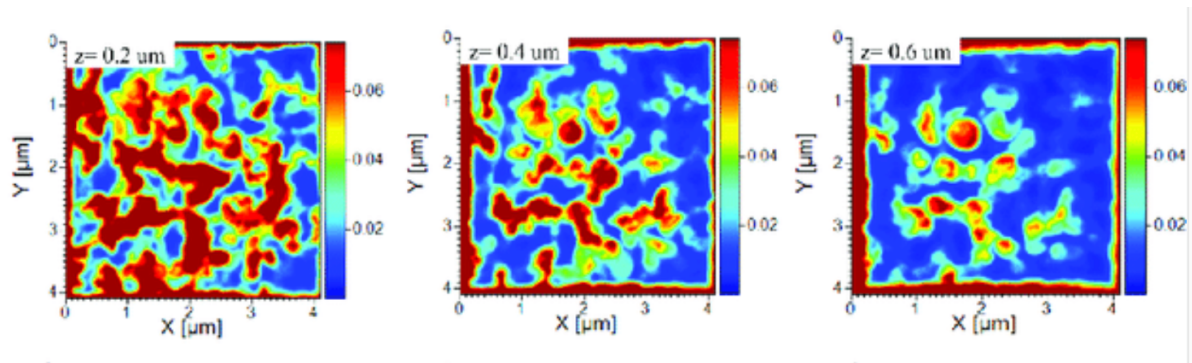
## *The Purpose of PPAs*

PPAs are added to HDPE pipe compounds to improve melt processing, especially for high molecular weight, low-sag HDPE resins. While these additives enhance manufacturing, they can have unintended consequences on welding integrity.

## *Uneven Distribution*

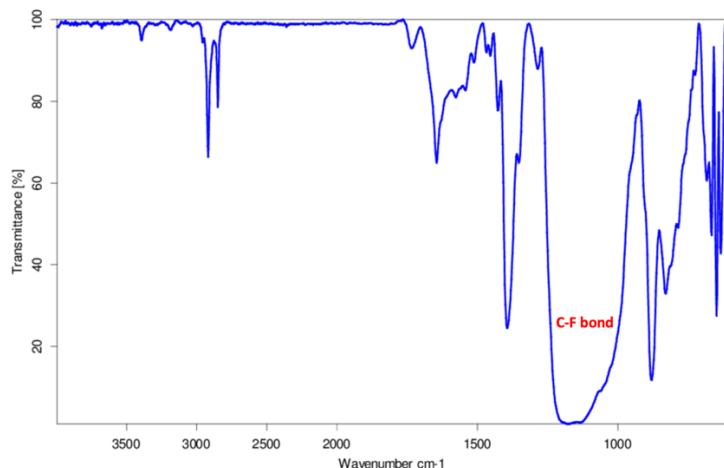
ToF-SIMS mapping has shown that these C-F fragments bloom unevenly to the pipe surface in patches (see images below). This patchy distribution explains

why EF welding specimens taken directly adjacent to each other can show different results – one passing and the other failing.



### *Testing for C-F Bonds*

ExcelPlas Polymer Labs offers testing services to detect these contaminants using Fourier Transform Infrared Spectroscopy (FTIR), they can identify C-F bonds in pipe peelings or shavings, with a broad diagnostic absorption band in the 1320 to 930  $\text{cm}^{-1}$  range (see spectrum below).



### *Implications for Manufacturers and Users*

This discovery has significant implications for both pipe manufacturers and users. It suggests that some processing additives used to improve pipe manufacturing processes may inadvertently compromise the integrity of fusion welding.

### *Legal Recourse*

For those experiencing unexplained EF welding failures or butt fusion brittle failures, ExcelPlas offers comprehensive, litigation-compliant failure analysis reports. These reports can be used in potential legal actions against pipe

suppliers who may have knowingly used additives that interfere with proper pipe fusion welding. This revelation highlights the need for ongoing research into the long-term effects of processing aids on pipe performance and weldability.

### *Next Steps*

To arrange testing simply send us a handful of peelings/scrapings/swarf from peeling/facing the problem pipe in a clean PE zip-lok bag.

**ExcelPlas Polymer Labs** can analyze the peelings/shavings for C-F bonds via FTIR using the diagnostic bands C–F peak from 1320 to 930  $\text{cm}^{-1}$ .

We can also conduct ToF-SIMS mapping that shows the local concentration of the C-F fragments which blooms unevenly to the surface of the pipe.

Visit ExcelPlas Polymer Labs: <https://www.excelplas.com/>

### **References and Further Reading**

#### **HDPE Pipe Resin Manufacturers Embrace Non-PFAS Polymer Processing Aids Amidst Growing Regulatory Pressure**

[https://www.excelplas.com/hdpe-pipe-resin-manufacturers-embrace-non-pfas-polymer-processing-aids-amidst-growing-regulatory-pressure/?utm\\_medium=email&utm\\_campaign=Poly-Pipe-News-PPN-Alerts-Sep-2023-Vol-2&utm\\_content=excelplas.com%2Fhdpe-pipe-resin-manufacturers-embrace-non-pfas-polymer-processing-aids-amidst-growing-regulatory-pressure%2F&utm\\_source=vision6.excelplas.com](https://www.excelplas.com/hdpe-pipe-resin-manufacturers-embrace-non-pfas-polymer-processing-aids-amidst-growing-regulatory-pressure/?utm_medium=email&utm_campaign=Poly-Pipe-News-PPN-Alerts-Sep-2023-Vol-2&utm_content=excelplas.com%2Fhdpe-pipe-resin-manufacturers-embrace-non-pfas-polymer-processing-aids-amidst-growing-regulatory-pressure%2F&utm_source=vision6.excelplas.com)

#### **PFAS-Free Processing Aids (PPAs) for Plastic Pipes Provide Better Processing and Results**

<https://www.plasticstoday.com/plastics-processing/pfas-free-ppa-provides-better-processing-and-results>

#### **EPA sets PFAS test for HDPE – Caution over use of Polymer Processing Aids**

<https://www.plasticsnews.com/news/epa-sets-pfas-test-hdpe-containers-faces-new-suit-inhance-case>