



STRESS?

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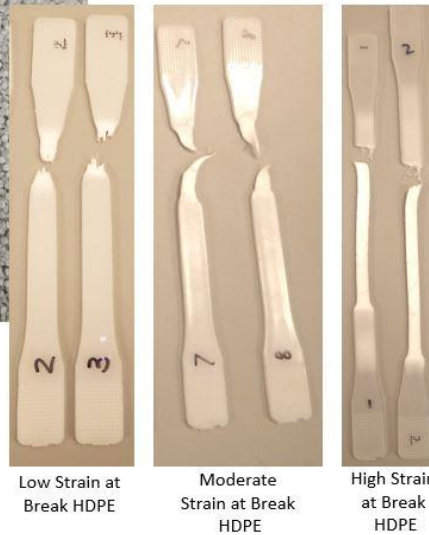
December 2019

Managing the Challenges of Off-Grade Resins

When a resin manufacturer receives a report of fresh lots, they decide which ones are *prime* and which ones are considered *off-grade* or *near prime*. The prime material gets *certificates* and is sold through their direct sales force. What falls outside the parameters is called *off-grade*, *near prime*, *pencil prime* or *excess prime*. Other lots are called *transitional* which is the resin made by transitioning from one grade to another. These resins may give a wide variation in densities and melt index within one lot and between multiple lots. This can cause variability in the mechanical, stability and processing properties and could result in catastrophic (or pre-mature) failure in the parts. This variability can also reduce the overall efficiency. If correct steps are not taken to mitigate those variations, the operational costs will increase, as well as risk of product failure. Reduced or variable molecular weight and density can lead to early creep flow and eventual rupture. Density differences in the third decimal place can result in drastically different stiffness and impact properties.



Off-Grade HDPE Resin



Low Strain at Break HDPE

Moderate Strain at Break HDPE

High Strain at Break HDPE

If the specifications are uncontrolled, a wide variation in properties within the same part or between parts will also appear. If there is no correlation between the raw material specification and the final part specification, there could be a strong chance of failure in the field.

In order to mitigate or minimize

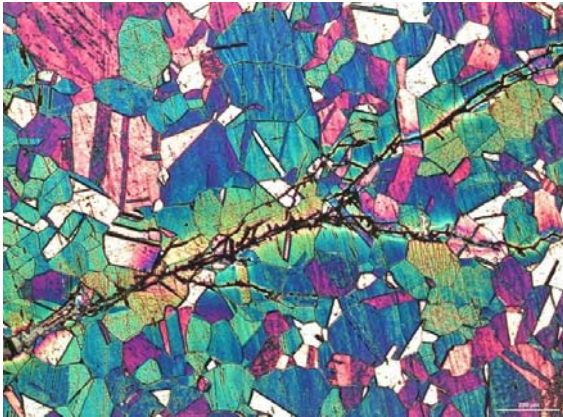
unwarranted increases in cost and premature failures, it is very important to understand the true variability of the off-grade resin and its effects on the desired process and product performance. In order to understand the true variability of the off-grade resin and its effects on the desired process and product performance, the following quality improvements are necessary:

- Defining specification on properties which correlates to product true performance.
- Correlating properties of incoming resins to the measurable product properties. New properties might need to be measured, such as carrying out oscillatory rheology to provide both viscosity vs shear rate at the processing temperature, but also provide subtle information about molecular weights and molecular weight distribution.

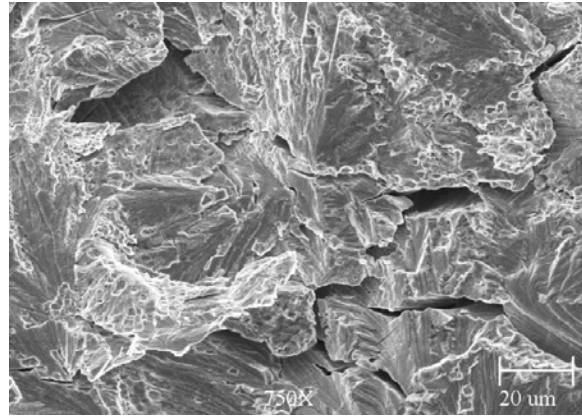
- Creating a quality plan to collect data and build the confidence and improve decision making in the future.
- The quality plan also helps in evaluating field failures.
- Specifications help in choosing further alternative resins which could provide further cost reductions and/or improved properties.

Stress Engineering Services (SES) has many years of experience in working with both prime and off-grade resins, and the process to qualify them to achieve more confidence in the process and product, both in the short and the long term. SES can support in developing appropriate test methods that can be individually tailored to desired processes and products.

SES Metallurgical Lab



Optical microscope view of cross section of chloride stress corrosion cracking in austenitic stainless steel.



Fracture surface of cross section of chloride corrosion cracking in austenitic stainless steel under a scanning electron microscope.

SES operates a full service metallurgical lab in Mason, OH providing metallurgical analysis and consultation services to a variety of industries including oil and gas, consumer products, and medical devices. One of the key offerings of the metallurgical lab is comprehensive metallurgical failure analysis of components. Irrespective of the industry, component failures very rarely have a single "root" cause. The physical failure of a component is often the culmination of a multilevel failure process involving a combination of design deficiencies, material defects, material degradation, manufacturing defects, service anomalies, and/or human errors. Failures of components in service have significant costs associated with them in the form of lost production time, collateral damage, and in extreme cases, personnel injuries. Metallurgical failure analysis is a crucial first step in implementing remedial steps to avoid repeat failures as it helps in identifying the damage made and cause(s) of failure. SES has a fully equipped metallurgical lab with a variety of instruments to perform non-destructive examination, metallography, fractography, and mechanical testing of materials on small and large scale components. While a metallurgical failure analysis is one of the most important steps in avoiding repeat failures, a comprehensive root cause analysis often requires a diverse team of engineers from various disciplines. SES metallurgical engineers work closely with mechanical design and testing engineers to provide value to its clients in delivering the critical services that are needed to avoid repeat failures, all under one organizational roof.



Fracture surface of a shaft that failed due to rotational bending fatigue.

Missed our previous newsletter?

Click here to read about our Materials Expertise and Capabilities for Enhanced Failure Analysis and our ISTA Certified Lab.

Stress Engineering Services, Inc. (SES) offers an integrated team of experts in creative design, functional engineering, design for manufacturing, materials, cost analysis, and reliability to deliver the highest level of innovation and technical success in developing products and packaging. SES provides expert engineering consulting services for:

- New Product Development
- Material Science
- Risk Assessment
- Human Factors
- Failure Analysis
- Package Development
- Testing
- Industrial Design

SES has extensive laboratory testing capabilities for evaluating materials, product performance, life assessment, and failure analysis. We have extensive simulation capabilities to predict mechanical, thermal, and fluid flow characteristics of complex problems.

Take your engineering to the next level. Find out more at innovation.stress.com.

To learn more about Stress Engineering Services, Inc., visit our website or contact us at 513-336-6701.

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ISO 17025:2005 Accredited for Several Test Methods
ISTA Certified Testing Laboratory Member

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