Polymer Film-Based Product Development, Manufacturing Support and Failure Analysis Services

OUR POLYMER LABORATORY CAN HELP YOU WIN FASTER IN A COMPETITIVE ENVIRONMENT

Whether it is the development of a new polymer formulation to achieve specific product objectives, characterizing/evaluating existing polymer structures for a new application, or testing to determine the life-limiting degradation mechanisms via accelerated aging techniques, Stress Engineering can support your application.

Our team is equipped with the experience and technologies to provide expert engineering design, analysis, testing, and custom R&D to support our clients at all stages of their unique product and process lifecycle.

One area of deep expertise is polymer films. Our portfolio of industry experience includes:

- **Health, hygiene, and medical films**
- **Packaging and thermoformable films**
- **Display and graphic films**
- **Films for electronics and electrical applications**
- **Films for adhesive tapes and liners**

The Polymer Laboratory at Stress Engineering Services, Inc. delivers a comprehensive range of engineering and testing services specifically focused on polymeric materials.

Dedicated Polymer Laboratory at Stress Engineering

513.336.6701
polymers.stress.com

ISO 9001:2015 & ISO 13485:2016 Certified
ISO 17025:2005 Accredited for Several Test Methods
ISTA Certified Testing Laboratory Member

STRESS ENGINEERING SERVICES INC.®

RESIN SELECTION
for Film Applications

Choosing the correct polymeric resin for the application, is imperative to producing a successful product.

Resin selection for extruded films, monolayer or multilayer, is a core expertise. We support new product development and cost savings efforts.

The resin selection process for film manufacturing is two-fold.

First, it is imperative to define the material selection criteria through an in-depth evaluation of the application to understand the optimal chemical structure based on the physical, mechanical, barrier, and rheological property requirements.

Second, after the foregoing parameters are identified, it is necessary to establish the appropriate material grade for the application as well as compatibility with the desired processing equipment.

To put the concepts of material selection into deeper context, take for example the end-to-end resin selection process for a multilayer film.

When developing the material selection criteria and chemical structure requirements, it becomes evident that the most important resin factor to consider is the rheological response of the different layers at the specific processing temperatures and rates. If not considered properly, instability defects will be a problem. From this understanding, the process moves from the specific client application to an evaluation of the portfolio of materials available from the resin suppliers. The Polymer Lab works with the suppliers and the client to identify the most appropriate resin grade for the applications.

Stress Engineering's resin selection process can also be used for lamination, coating and any other post processing operations involved, such as embossing, printing, ETO sterilization, radiation sterilization, and metallization. The choice of material and structures is made with your existing production capabilities in mind.

FILM-BASED
Product Design

Film design is based on the material selection and the process used to manufacture film-based products.

Our team translates your application and specific needs into key performance requirements. We anticipate plausible failure modes and translate them into robust product specifications.

Design requirements vary from hard casings for BOPET-based films to low cost, flexible or heat resistant films. Based on the application, there are many questions which need to be answered relative to the performance of the films: High barrier or breathable? Tough or brittle? Transparent or opaque? These are critical to understand in order to drive optimal performance.

From a product design standpoint, a constant material thickness through the film cross section is most desirable and we have extensive experience with advanced gauging techniques to produce films with improved thickness and narrow property variations across wide web widths.

A thorough consideration of all the relevant material parameters takes the uncertainty out of your commercial decision making, effectively simplifying the complex decisions associated with product design by following this process.

This quantitative approach helps to ensure that you get it right the first time: a brittle film for an easy-open package, a transparent film for an optical application, or an opaque film for printing enhancement. Whatever the need, you derive value from having a multi-disciplinary expert team with the knowledge and the experience to inform key product design decisions.

CAST AND BLOWN FILM EXTRUSION

Manufacturing Development and Troubleshooting

Cast and blown film extrusion have a distinct place in product design based on the properties achieved from each process and the cost. Stress Engineering has experience with development and troubleshooting of monolayer and multilayer cast films and blown film processes, including extrusion processes (both single and direct twin screw), die and feed-block selection, web handling, in-line converting, and roll winding.

Blown film generally provides a tough, resilient film by using low melt index resins and biaxial orientation, whereas cast film is soft and easy to stretch. For example, for wrapping pallets, cast film provides greater load retention compared to blown film, as an optimum yield point can be achieved with a cast film. Blown films need to be thicker to achieve the same yield (as cast films) due to its mechanical properties.

Typically tear properties of blown films are superior to cast films. However, with the advent of improved cast resins and multilayer technologies, these differences have become minor.

When clarity is important, the cast process is ideal as the rate of cooling of the melt is significantly greater than possible with blown film. This also provides higher line speeds for the cast film process. However, the blown film process is easier to manage and can provide twice the width of the lay-flat bubble diameter, leading to optimized cost. The flatness of the roll in a blown film process is also far superior, as the complete bubble can be rotated to avoid gauge bands, but local thickness variation range is smaller in cast film process with appropriate thickness gauge usage.

Blown Film Extrusion Process

Extrusion Processing

Cast-Oriented Film Winding Process

MORE THAN 45 YEARS OF PRODUCT DESIGN

and Failure Analysis

With over 45 years of experience in design, testing, and analysis, The Polymer Lab at Stress Engineering Services, Inc. is on the leading edge of understanding the science behind these materials.

The collective experience within our focused polymer science team combined with state-of-the-art laboratory facilities gives us the tools needed to thoroughly evaluate materials in all their various forms, including films.

Testing and failure analysis help in identifying the failure modes and specifying film properties for various products in markets such as medical, consumer, electronics, industrial, display, safety, and automotive.

FILM AND LAMINATE CHARACTERIZATION

Comprehensive Testing and Analysis

We provide standard and customized test methods to evaluate film materials, processes, and final product.

The services we offer for analyzing films include:

1. **Compositional Material Analysis:** DSC, TGA, and FTIR are used to determine the polymers and additives used in film manufacturing.
2. **Material Processability:** TGA, TMA, DSC, MFI, and Rheology are used to determine processing conditions for the material of choice.
3. **Material Properties:**
   - Mechanical: tensile, flexural, tear, biaxial, burst strength, impact, and peel strength of various seals in the film components and products; high strain rate testing to evaluate the material properties during high speed processing and in final application.
   - Physical: thickness, specific gravity/density, surface energy, and topology using SEM EDS and optical microscopy; moisture content.
   - Thermal: Tg and melting temperatures using DSC, DMA, TMA; thermal stability using TGA; coefficient of thermal expansion using TMA; film shrinkage using TMA and standard oven measurements.
   - Optical: UV-vis spectroscopy, transmittance, absorbance, haze, yellowness index, gloss, color space.
   - Barrier: water vapor transmission, permeability against solvents and vapors.
   - Long term performance: creep and stress relaxation at ambient, sub-ambient and elevated temperatures; weathering; aging in harsh chemicals and cleaners.
4. **Film Layer Analysis:** Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM-EDS) is typically used for film layer analysis when the layers not pigmented. Optical Microscopy (OM) can be used when optical contrast between the layers exists.
5. **Contamination Analysis:** FTIR, SEM-EDS, and OM are used to identify contaminants in the film structure.
6. **Competitor Product Analysis:** FTIR, TGA, GPC, and SEM-EDS along with standard extraction techniques.
7. **Surface Analysis:** Surface energy could be measured either by utilizing standard surface tension fluids or even measuring the contact angles. This is very important for improving adhesion of printing inks and adhesives on the film substrates.
8. **Custom Test Development:** We can work with you to design the appropriate test method to evaluate the properties needed for the application in the desired market.

If you need high quality material data and analysis at competitive rates and rapid turnaround, call Stress Engineering today!

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