Baerlocher USA- Vinyl Recycling Summit 2021 Mechanical Recycling

Enhancing Recycle Quality by Replenishing Consumable Additives

Baerlocher USA

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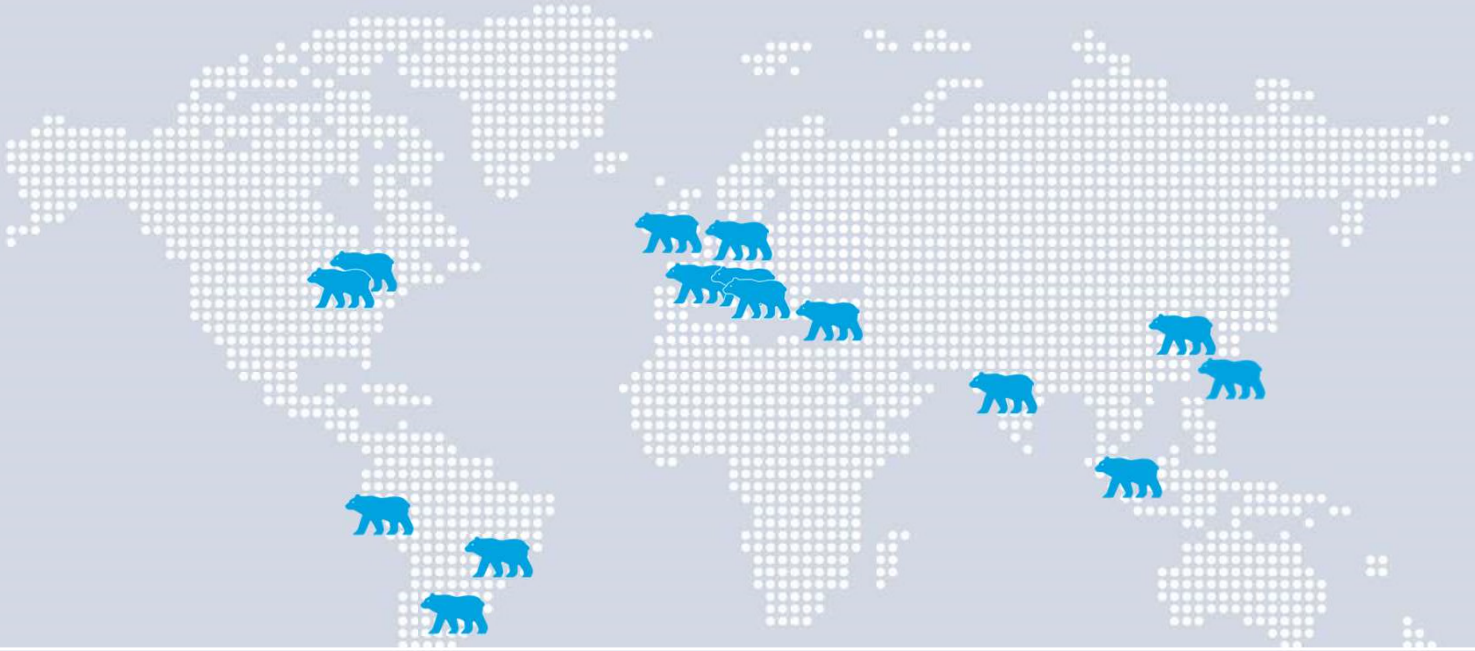
Your global partner for additives

Baerlocher Group of Companies serves local customer needs with innovative / customer tailored solutions.

- Global leader in PVC additives: Leader in Ca-based solutions, Liquid Mixed Metals, Lubricants
- Global metal soaps specialist and trusted partner for BAEROPOL solutions
- About 1200 employees worldwide representing a trusted and reliable partner
- 190 years of experience

Manufacturing Companies: Countries



Germany UK	Italy I Italy II	France Turkey	Brazil Peru	USA I USA II	San Marino Korea	Argentina China	India Malaysia

Polymer Stabilization Basics

Polymers are specifically stabilized for a given end use application and to meet processing requirements

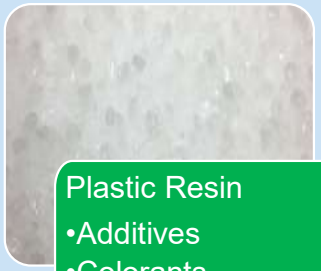
Most polymers today are stabilized to meet a customers needs for a single time through the production process followed by the expected shelf life of the finished part.

Stabilizers and lubricants are sacrificial in nature and therefore get partially consumed during the process of protecting the polymer structure

The more a polymer is stressed, the less stabilizer and lubricants remain in the active state

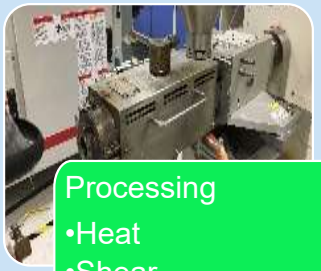
Addition of stabilizer to post consumer recycle allows for retention of the resin's initial aggregated properties

Recycling with Added Stabilizer Packages



Plastic Resin
- Additives
- Colorants
- Residues

1st



Processing
- Heat
- Shear

2nd

End Product
- UV Light
- Chemical Exposure

Nth

Flake/ Repelletization
- Heat
- Contamination

Recycled resin: What we see coming into our lab

- Baerlocher works closely with many converters of recycled resin
- The resin that arrives in our lab can take many forms and conditions
- As a polymer stabilization company, we see many types of customers with varying problems and methods
- Almost all recycled polymer we have seen is deficient in stabilization

Recycled resin: What we see our customers doing to polymers

- Since our lab is highly engaged with recycling customers we see many things that they do to polymers:
  - Customers who over heat resin during extrusion to dramatically change rheology
    - Extruding at higher temperatures than is necessary
    - Severe degradation occurs, i.e. chain scission, cross linking, evolution of gases
  - Customers who do not stabilize resin that is extruded multiple times
  - Customers who use the wrong stabilizer for the application
  - Customers who abuse internal recycle that could be reused like prime resin

US and EU Difference

- Legislation allows Europe to be more technologically advanced
- Lower processing temperatures in Europe
- Cleaner recycle streams in Europe
- PVC producers are required to take back material at end of life (window profile, flooring, etc.)
- Recycle is being actively used in higher end/durable application (i.e., interior automotive) in Europe
- Europe is more open to and typically uses stabilization to increase quality

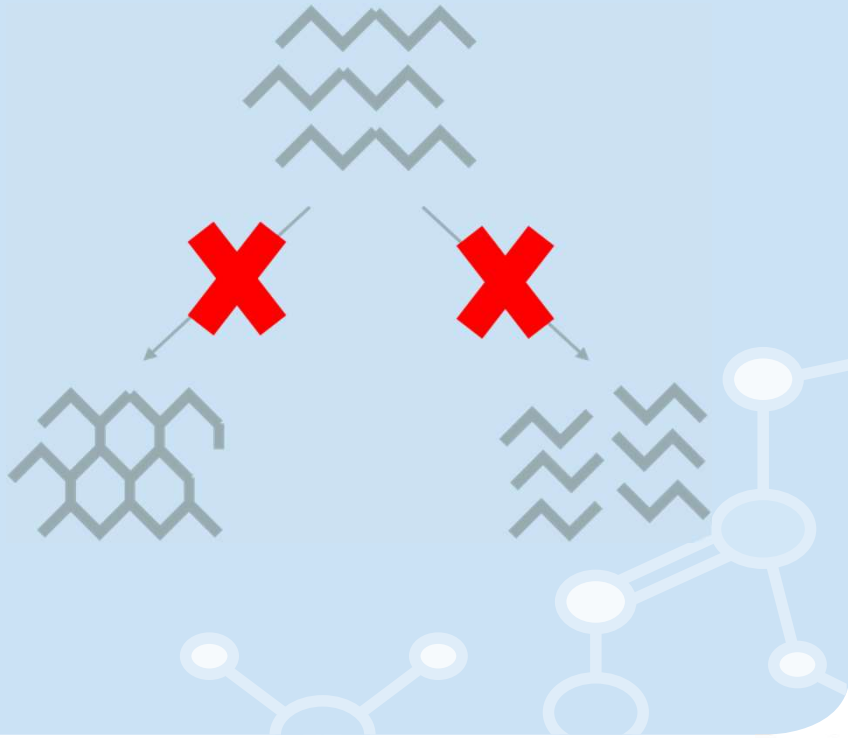
Stabilizers, Lubricants, Antacids and Antioxidants

Prevent material sticking to the die and smooth the processing by replenishing the stabilization package

Reduce metal corrosion, color changes, and improve melt stability

Prevent breakdown of the polymer during processing

- Delay yellowing
- Reduce change in molecular weight
- Preserve mechanical properties
- Prevent change in rheology



Proven Experience Model to Follow

- Polyolefins RST (Resin Stabilization Technology) and T-blends
- Addition to PCR allows recyclers to stabilize the quality of the resin as it is subjected to additional heat histories
  - Stable rheology
  - Improved long term stability
  - Color retention
  - Reduce gels
  - Increase recycled resin in your products
  - Reach new end markets
  - Reduce waste

Applications of Baerlocher's Stabilizers

- Pre Stabilize prime resin to allow for improved recycle
  - Reduced gels
  - Recycle similar to prime resin
  - Improved long term stability
  - Prevent color shift in recycle
  - Improve color for prime parts
- Post consumer recycle stabilization
  - Better long-term stability
  - Improved melt stability
  - Prevent melt shift with subsequent extrusion

Proven Success Benefits by Application

Film

- Prevent gels and pin-holes
- Improved bubble stability
- Achieve higher recycled material content
- Better color in natural grades

Rigid

- Melt flow stability
- Long-Term Stability
- Color preservation for natural grades
- Increased recyclability

Baerlocher Innovation – Focused on Solutions for Recycling Additives

- One-to-one solutions for recycling applications
- Experimental concepts involve combining stabilizers with additional functional additives

Experimental Work – Baeropol GS 1937 PE/PP Compatibilizer

- Extruded reference showed severe sharkskin effect
- +2% Baeropol Experimental product
  - Better surface, no rotational memory

+ 2% Baeropol Experimental Product

Product Forms

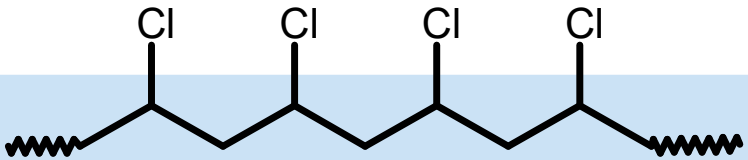
Product Form Convenience

Easy to introduce to post-industrial and post-consumer materials

Stabilizers and additives can be dosed via different methods:
Metered in at Extruder
Mixed with Preblends
Mixed with Masterbatches
Dry blend with Recyclate
Compounded

Small loading recommended (0.1% - 3%)

PVC Recycle



Without Stabilizers or lubricants, plastic would be un-processable. Having too little will also cause issues.

During processing, some of your lubricant and stabilizer ingredients get consumed. The more a polymer is stressed, the less stabilization remains. Burning is an irreversible chemical reaction, so stabilization is vital to the process.

Along with controlling the burning and sticking of the material during processing, these ingredients can help with run rate, pressure, fusion, surface appearance, color hold, and desired physical properties

As with all stabilization, results may vary between different material recyclate quality, aesthetic goals, processing conditions etc.… some formulation tweaking is expected to optimize performance.

Incompatible Additives in PVC Recycle

Additives such as Lead (Pb) or Cadmium will react with Tin stabilized PVC, causing them to discolor and possibly effecting end properties. Although these additives are legacy here, they are still in imported finished goods and become our problem to recycle.

Indoor application materials recycled into outdoor applications will not have the proper weatherability

Wire and Cable recycle will contain ingredients such as hydroxides that can react with other recycle streams such as food film which contain antioxidants

Varying levels of compatibly with plasticizers

Micro additives can migrate to the surface over time

Ideally, you want to put like application recycle streams with each other

Conclusions

Stabilization/lubrication is important to the recycle of polymers

Most polymers are not intended for recycle so additional stabilization is needed

There are many options for addition of stabilizers

By stabilizing it is possible to upcycle resins to make higher quality products

Stabilization also improves reproducibility in molding, extrusion, and mechanicals

Conclusions

While there are many challenges that face the recycling industry, enhancing quality is within our control.

As demand is the key to increased rates of plastic recycling, properties must be enhanced to meet new expectations.

Stabilizer packages have shown historical success in enhancing the circular economy, but there are still many opportunities for adoption.

Baerlocher provides cost-effective, easy-to-use options for users of recycled polyolefins to improve long term thermal stability, stabilize melt flow, improve film processing, etc. and is applying this technology to the PVC recycle industry.

Continuing the PVC Recycle Conversation

What Forms are currently taken?

- Powder
- Pellet
- Pastille
- Prill
- Granular
- Liquid
- None

Market's Needs?

- Increase Recycle content
- Circular Economy
- Improve processing
- Improve physical properties

What issues and defects are you trying to control?

- Material Properties
- Visual Quality
- Processing Conditions
- Compatibility of stabilizers and other additives

Educate

- Baerlocher Virtual PVC Technical Summit August 24th-25th, 2021

For More Information

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