CASE STUDY

# **Doverphos® LGP-12** – A Solution to Gel Issues in PIR and PCR Streams



## Summary

**Product type:** **Doverphos® LGP-12**
**End applications:** **Film applications**
**Key benefits:** Effective thermal stabilization | Good processing stability | Low volatility | Regulatory compliance (FDA approved)

## The Challenge

The use of **Post-Consumer Resin (PCR)** and **Post-Industrial Resin (PIR)** in film production is subject to increased scrutiny from various perspectives, including social, environmental, and legislative concerns. However, incorporating recycled streams presents challenges that can adversely affect the overall physical properties of the film. Recycled streams are usually of a lower quality than virgin resin, leading to poorer quality resins overall or, in many cases, increased plastic and film thickness, often using more virgin resin.

**Gels**, which refer to visual or structural defects in the film, can have a detrimental impact on elongation strength, leading to premature tearing. Gels can arise from contamination caused by water and debris, but effective filtration and production practices can prevent their formation. Another type of gel is attributed to cross-linked resins, typically arising from inadequate stabilization and/or excessive heat.

During re-granulation, PCR and PIR exhibit insufficient stabilization, leading to excessive gel formation that reduces tear and elongation strength of the film Consequently, more virgin resin is necessary to compensate for the inclusion of lower-quality PCR to achieve a similar performance as virgin resin in stretch film. Approximately 40% of gel formation occurs during the automatic conversion of recyclate into pellets, and higher gel content increases the risk of film breakdown. The larger gel impact is shown in Fig. 01

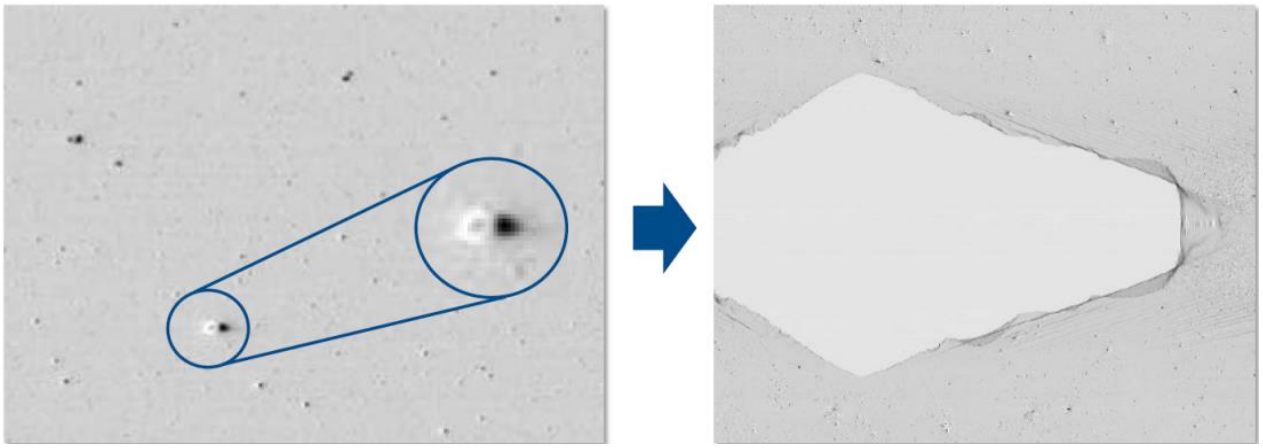


*Fig 01: Larger Gel Impact, Source: Optical Control Systems, GmbH*

Once gels appear within the PCR / PIR, nothing can be done. Thus, to enhance film quality, it is crucial to incorporate additives into the stream that **prevent gel formation** without compromising the overall quality or recyclability of the film.

## The Solution

**Doverphos® LGP-12**, an innovative proprietary liquid polymeric phosphite stabilizer, presents a promising solution to gel formation issues. Unlike traditional phosphite stabilizers like trisnonylphenol phosphite (TNPP), LGP-12 stands out for its alkylphenol-free composition and its bio-sourced raw materials. This unique stabilizer is compatible with thermoplastic resins, effectively reducing additive migration and therefore eliminating plate-out and blooming of the phosphite.

To address the thermal instability challenges faced by resin formulators, Doverphos LGP-12, an **alkylphenol-free antioxidant**, offers several advantages when integrated into resin formulations. The following advantages highlight the benefits of integrating LGP-12 into resin formulations:

### Adding LGP-12 at the right time

**Doverphos® LGP-12** scavenges free radicals generated during the thermal degradation of polymers, effectively preventing gel formation and other degradation byproducts. The best time to introduce LGP-12 is during PCR re-granulation, as otherwise the material undergoes heat cycles without stabilization, resulting in more **pronounced gels**.

To substantiate this claim, a comparison was made between virgin resin combined with 30% PCR treated with LGP-12 and untreated PCR.

Table 01 presents the findings:

*Table 01: Total Gel Count of 30% Recyclate Streams*

| Time (h) | % PCR | Gel Count by Size (Microns) | | | |
|---|---|---|---|---|---|
| | | <800 | 800-1600 | 1600-2400 | >2400 |
| 0 | **25** | **5064** | **102** | **14** | **33** |
| 8 | 25 | 1417 | 46 | 32 | 96 |
| 20 | 25 | 719 | 21 | 7 | 24 |
| 32 | 25 | 709 | 9 | 2 | 2 |
| 44 | 25 | 2633 | 46 | 1 | 10 |
| 46 | 30 | 923 | 95 | 13 | 52 |
| 47.5 | **30** | 1358 | 40 | 0 | 0 |
| 47.8 | **30** | 1259 | 31 | 0 | 0 |
| 48 | **30** | 2062 | 41 | 1 | 0 |
| 50 | **30** | 1521 | 7 | 0 | 0 |
| 51 | **30** | 358 | 5 | 0 | 0 |

LGP-12 INTRODUCED

Within 2 hours of adding LGP-12, gel sizes exceeding 1600 microns were eliminated, and a significant reduction in the 800–1600-micron range was observed. Additionally, gel sizes below 800 microns were significantly reduced from 5064 to 358.

To validate the claim, an experiment on larger production lines was conducted by pre-dosing PCR and PIR with LGP-12, measuring the total gel count before and after adding LGP.

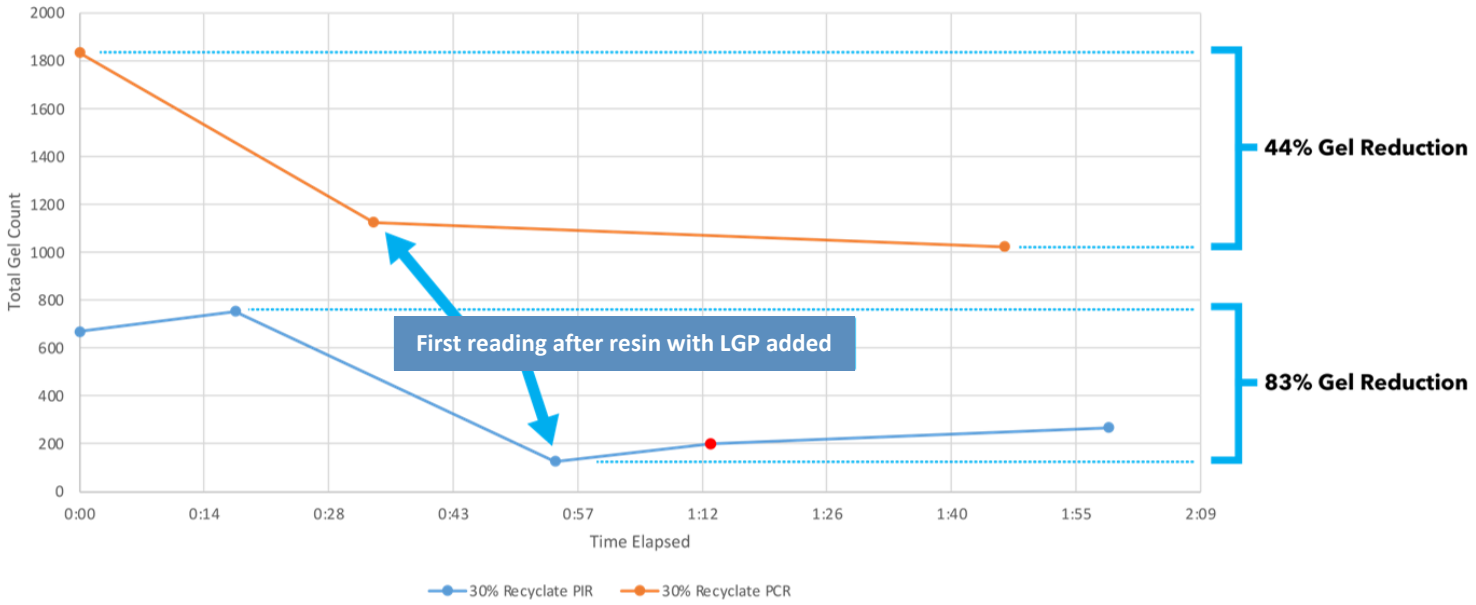



*Fig 02: Total Gel Count of 30% Recyclate Streams*

The results showed a considerable reduction in total gel count with the addition of LGP-12 in the PCR/PIR at the appropriate stage. The solution incorporating 30% recyclate PIR exhibited a 44% reduction in gels, while the solution with 30% recyclate PCR demonstrated an 83% reduction, significantly enhancing the final film quality and, ultimately, the resin.

### Improved processing characteristics

LGP-12 plays a key role in preserving the **Melt Flow Index (MFI)** of the resin, leading to comprehensive stabilization and smoother processing. A lower MFI in resins results in a more-viscous material, which needs more energy in order to be extruded, often leading to higher temperatures of extrusion. Higher temperatures of extrusion can lead to higher gel counts, but maintaining the MFI ensures that the resin is properly stabilized, thereby reducing the occurrence of gels. This prevention of gel formation is crucial for achieving high-quality final film products.

The effectiveness of this stabilizer in minimizing gels was validated through an experiment that involved three trials, comparing fluff resin, recycling pellet, and LGP-12 pellet. The experiment's results confirmed the positive impact of Dover's LGP-12 in preventing gel formation and maintaining the desired film quality.

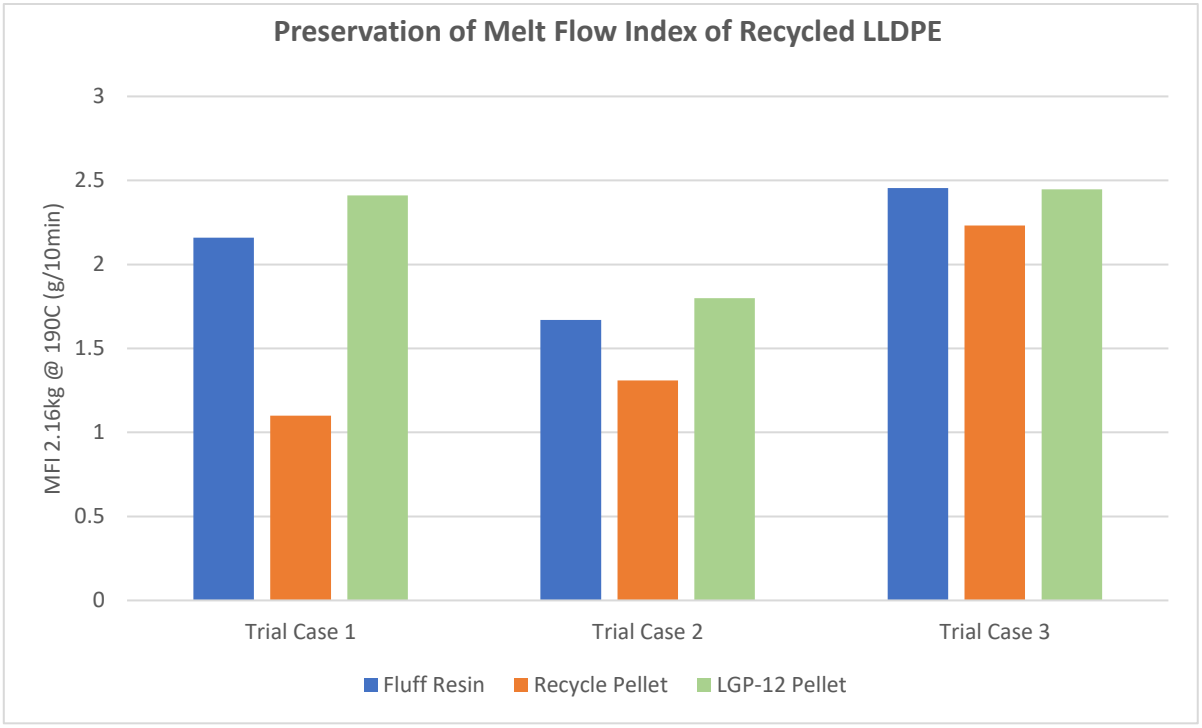



*Fig 03: Total Gel Count of 30% Recyclate Streams*

## Conclusion

This case study analyzes the challenges faced by plastic product manufacturers and formulators when trying to reduce the formation of gels in PCR resins, and how the timely addition of LGP-12 into the recycled stream has an almost immediate effect in gel reduction. Below are the primary advantages of Dover's latest liquid polymeric phosphite stabilizer for PCR and PIR recyclate:

- Reduced gel formation
- Improved thermal stability with a controlled Melt Factor Index (MFI)
- FDA approved.

If you want to give your customers the best plastic-based goods experience possible, consider adding LGP-12 to your products.

**Don't hesitate to get in touch with the Dover team right away!**

Click on the button below to request a sample for

**Doverphos LGP-12**