

# AMI: Polyethylene Films 2021

## ANALYSIS & TESTING FOR BETTER PPA MASTERBATCHES

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**Ingenia Polymers Corp.**



## Ingenia at a Glance

- Founded in 1986 as WedTech and renamed Ingenia Polymers Corp. in 1998
- Five manufacturing sites: Brantford (Canada), Calgary (Canada), Houston & La Porte (USA), and Al-Jubail (KSA)
- Specialized in Additive and Pigment Masterbatches, Superlink™ and Rototuff™ rotomoulding compounds, and additive Superblends™



# PPA Fundamentals

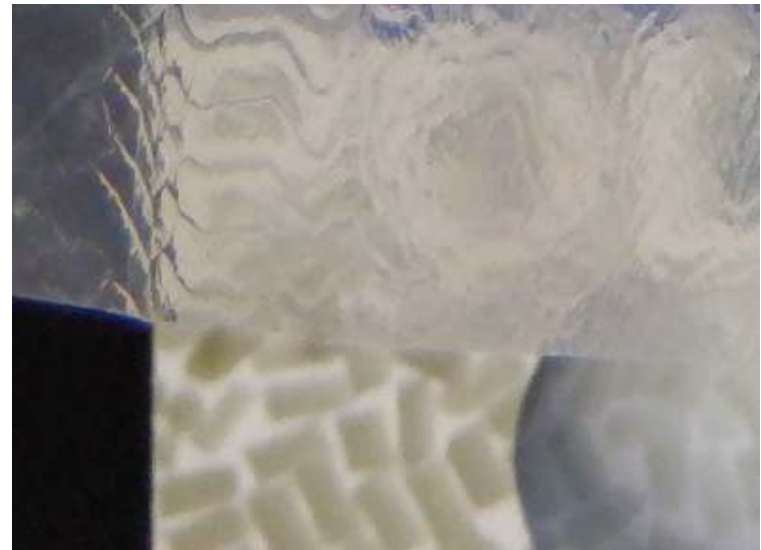
- Polymer Processing Aids – Fluoropolymer (plastic or elastomer)
  - Usually combined with a PEG or PCL synergist
- Coats the metal surfaces of the extruder/die, reducing friction
  - Elimination of melt fracture, reduction of die buildup
  - Better flow = Less material hang-up = Less oxidation & gel formation
- Performance impacted by a wide range of factors:
  - Fluoropolymer structure
  - Delivery method
  - Process equipment & conditions
  - Other additives

# Why a Masterbatch?

- Why not direct addition?
  - Particle size critical to PPA performance
  - For fluoroelastomer PPA's, ideal particle size is 2-10  $\mu\text{m}$
  - Low dosage favors dilute form
- Why not use PPA-loaded resin?
  - PPA requirements structure, process-dependent
    - Allows you to precondition ('shock') your extruder on start-up with extra PPA

# Time-to-Clear (TtC) Melt Fracture Testing

- Representative test of PPA performance in film processing
- Measures time from PPA introduction to total elimination of melt fracture
- Time to complete coating depends on:
  - Rate of PPA deposition on die
  - Rate of PPA removal from die



# Test Conditions

- Test resin – *b*-LLDPE
  - MI 1.0, 0.918 g/cm<sup>3</sup>
  - No added antiblock, slip, or PPA
- High shear rate – 300 s<sup>-1</sup> apparent\*, 390 s<sup>-1</sup> actual
- Low shear rate – 170 s<sup>-1</sup> apparent\*, 225 s<sup>-1</sup> actual
- PPA loading increased each hour: 300→600→900 ppm
  - 2% masterbatches, letdown ratio from 1.5 → 4.5%
- 2500 ppm diatomaceous earth, added in a separate masterbatch

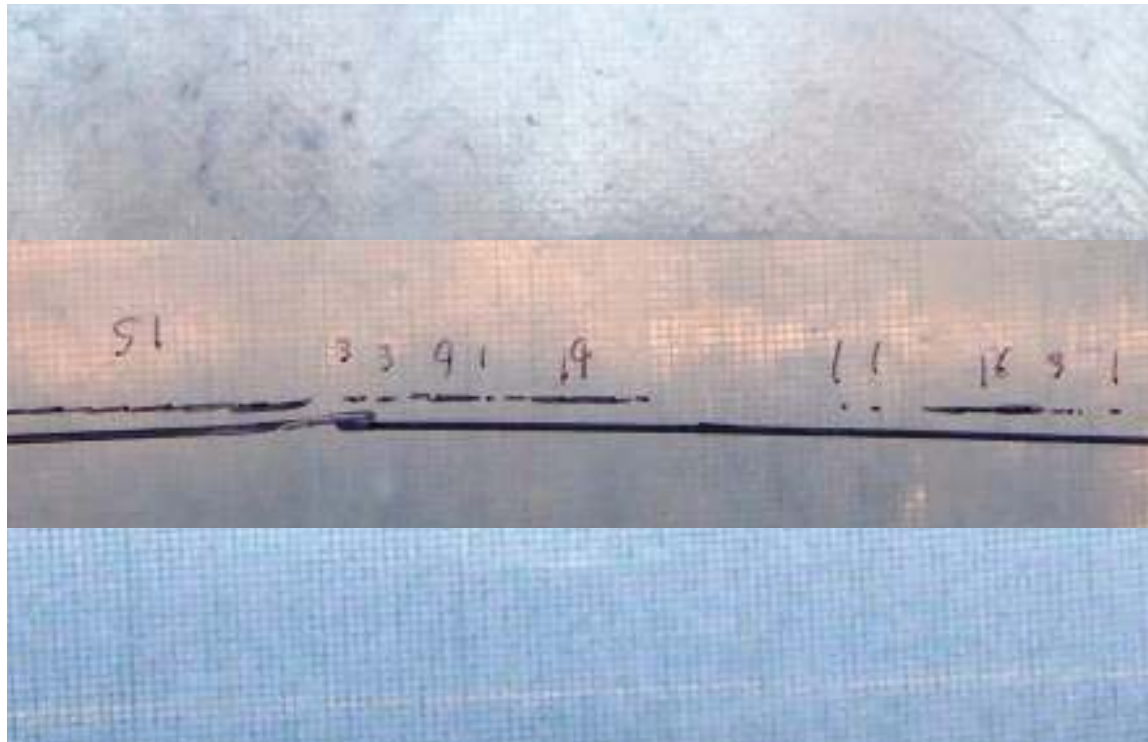
\*Industry literature typically reports apparent shear rate

# Melt Fracture Evaluation

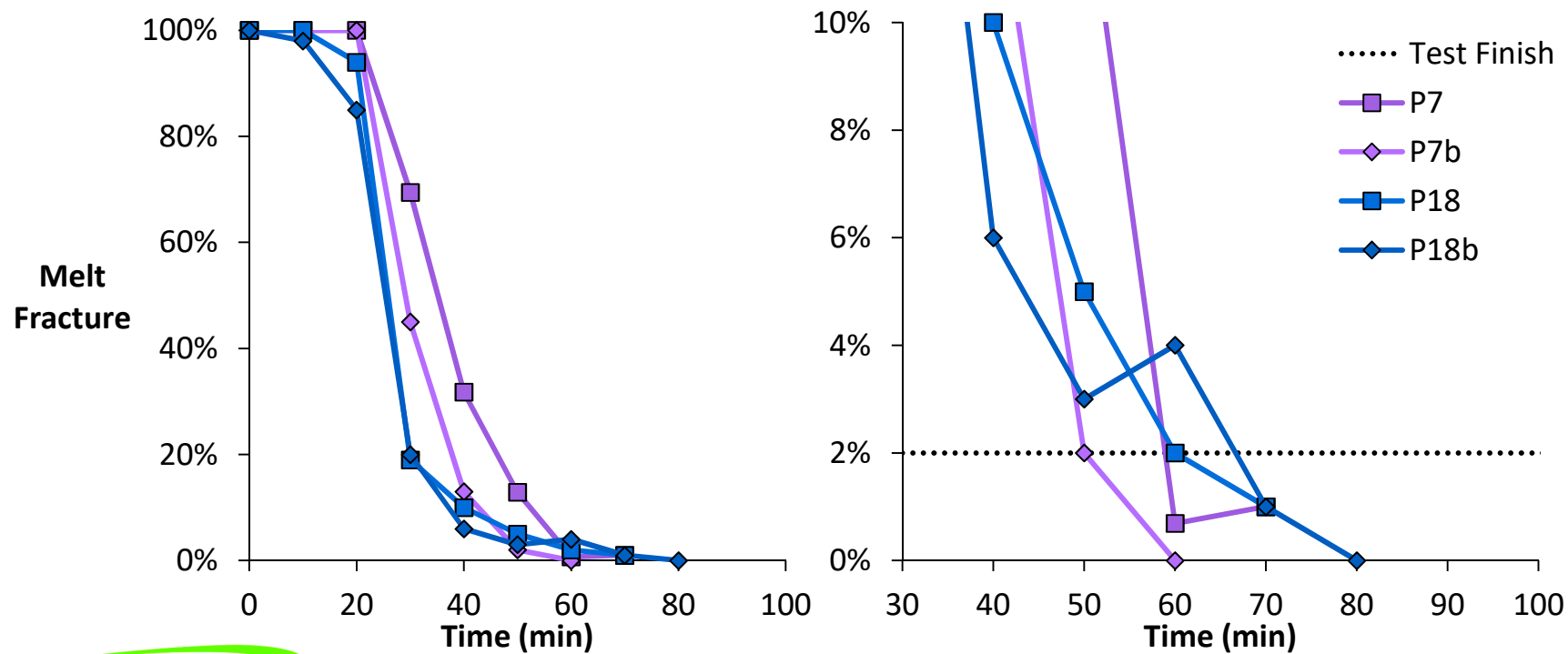
0 minutes

30 minutes

60 minutes

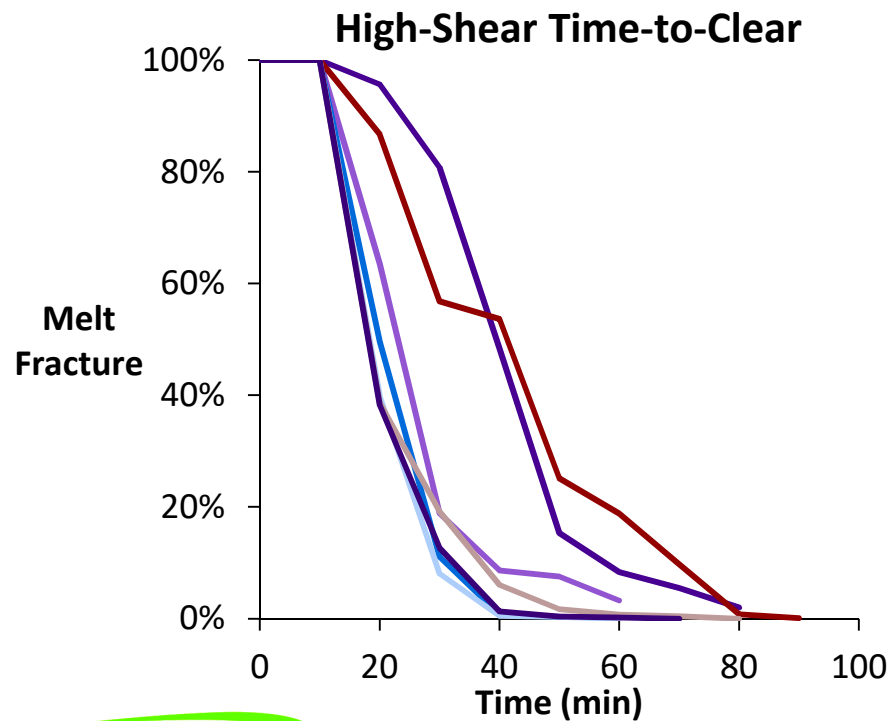


## Test Outcomes: Repeatability



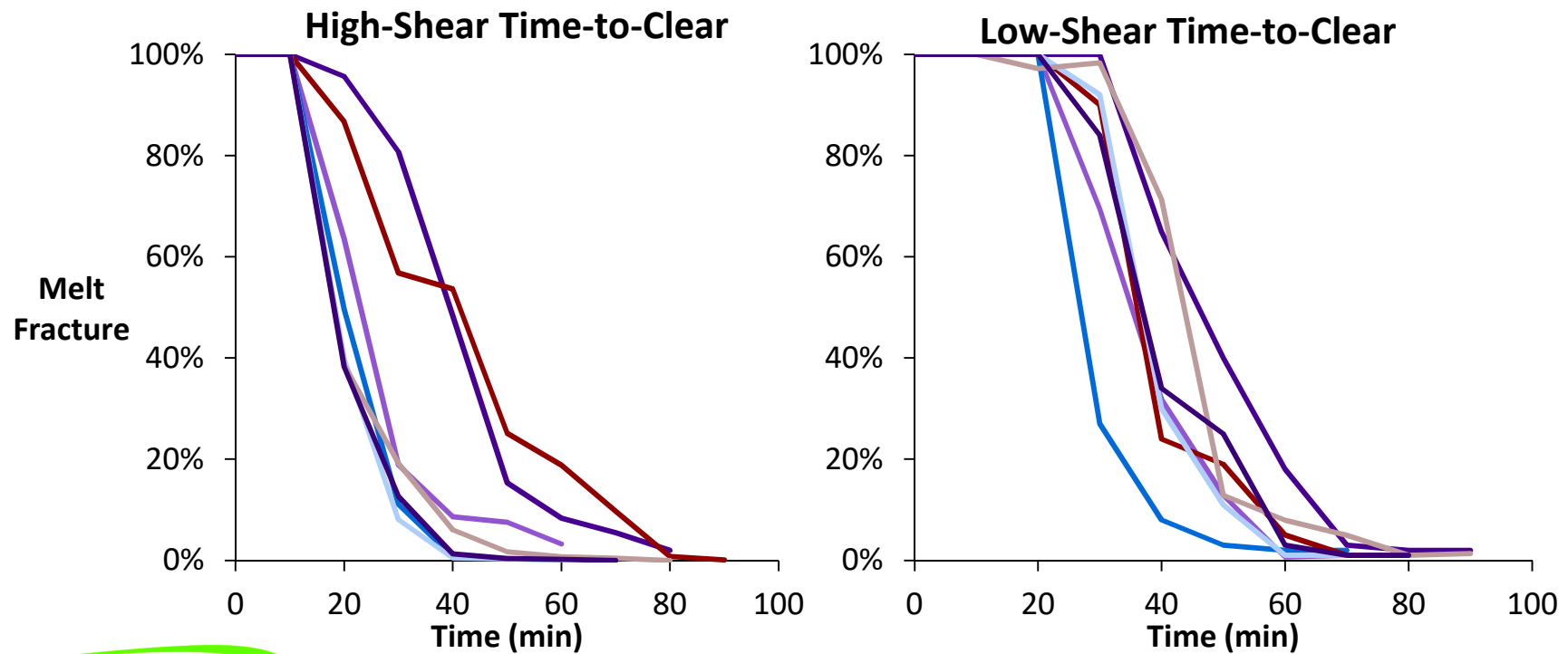


## Test Outcomes: Commercial Field

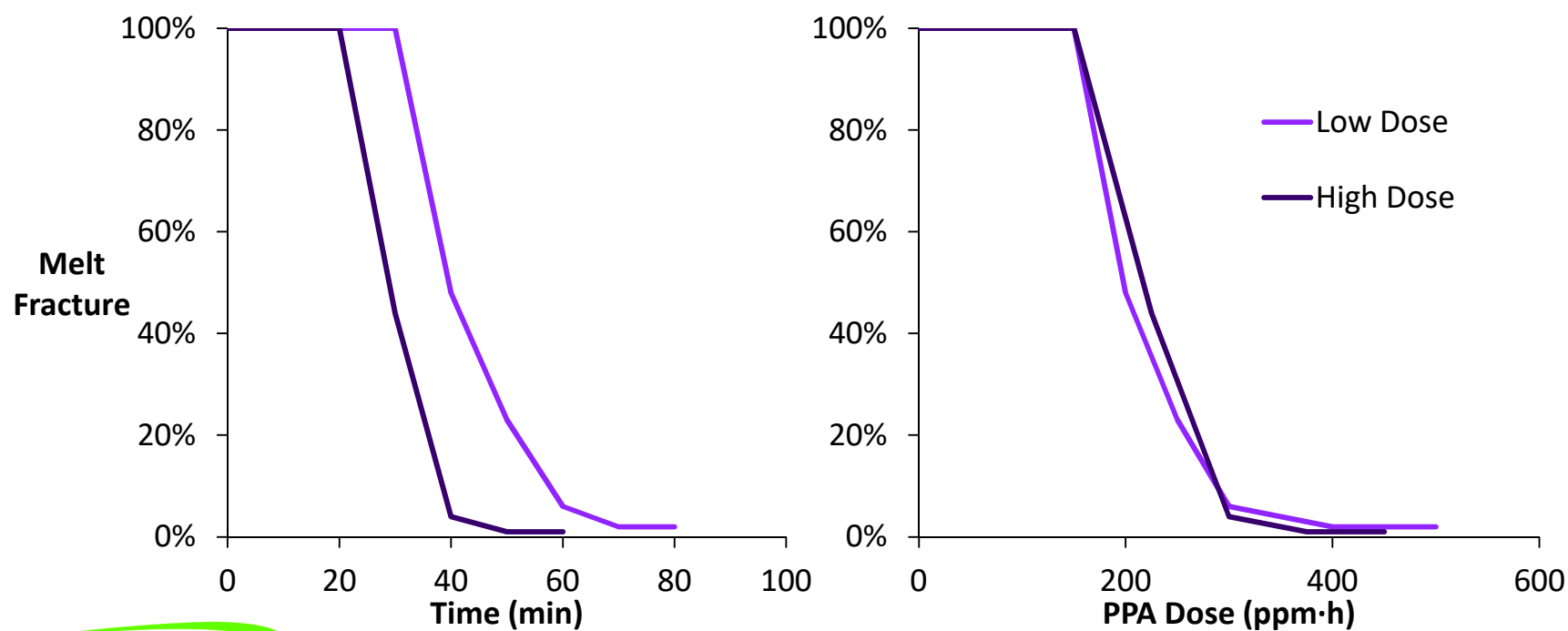


- Commercial PPA's show a range of performance levels
- In our testing, newer grades showed significant reduction in TtC over older products

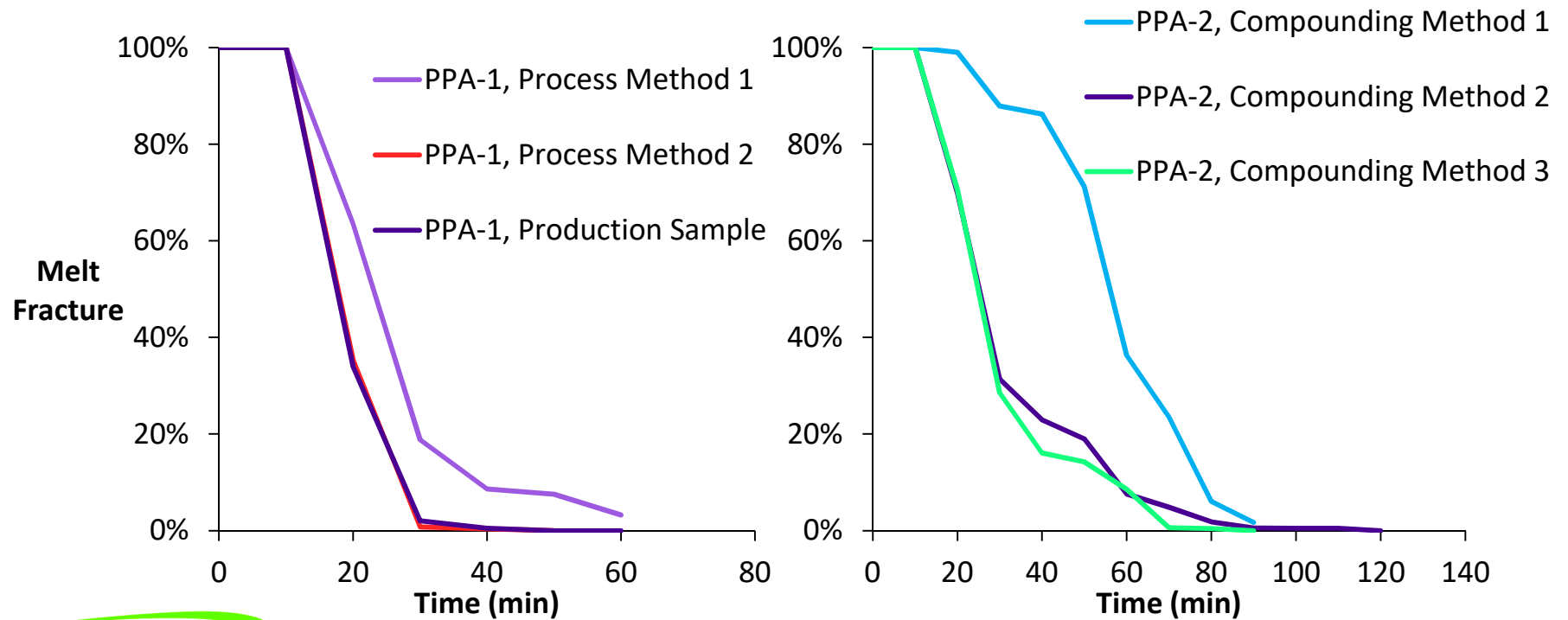
# Test Outcomes: High- vs. Low-Shear Performance



## Test Outcomes: PPA Use Level



# Test Outcomes: Impact of Preparation Techniques



## Development Outcomes: New Formulations

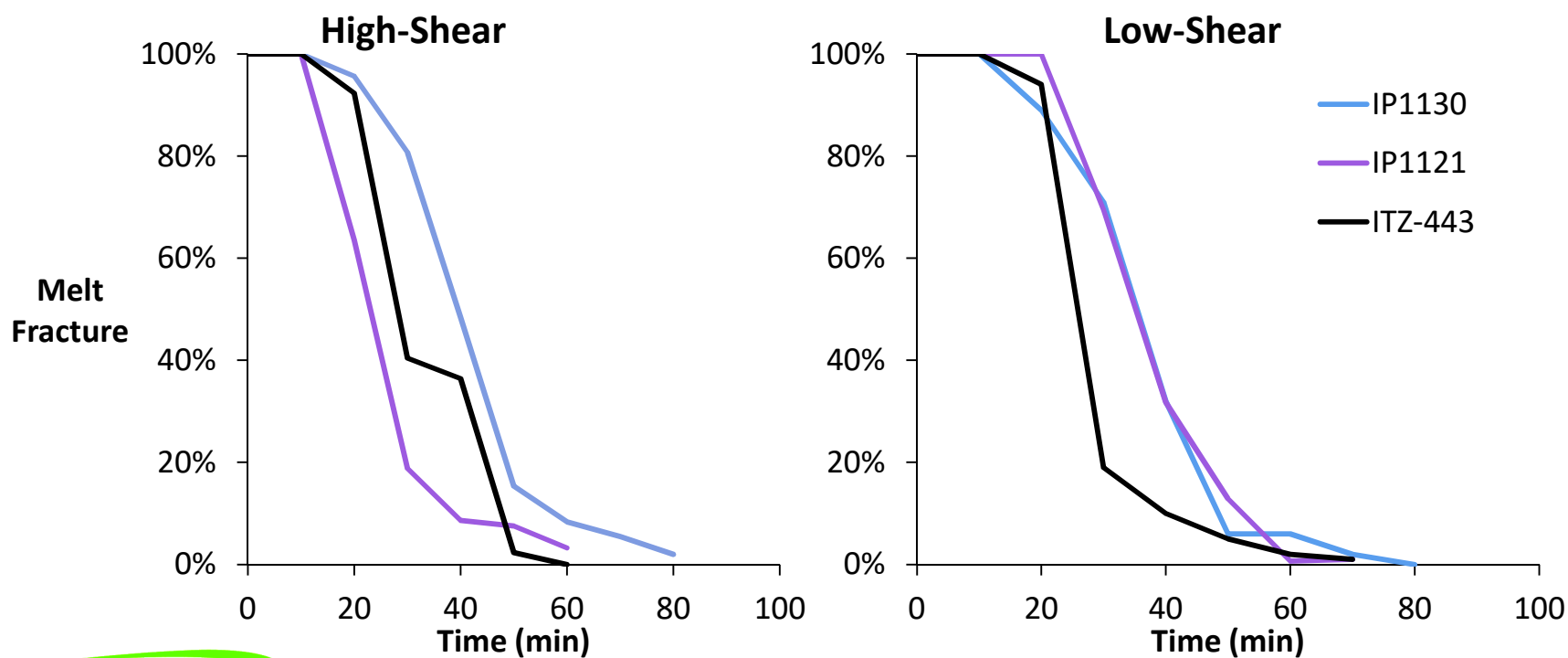
### **ITZ-443**

Developed based on new insights into processing & formulation

Designed to match performance of existing PPA's

Better economics

## Development Outcomes: Formula Performance



## Summary

- While time-consuming, TtC melt fracture is a key test in evaluating performance of PPA masterbatches
- Good compounding & process design lead to better PPA performance
- TtC testing and other evaluations have allowed Ingenia to develop a new PPA masterbatch offering, **ITZ-443**
  - Designed to perform similarly to Ingenia's existing offerings at a better price point



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