

LIMITATIONS & LEVEL OF ACCURACY OF TESTS FOR ROTOMOLDING POWDERS

**Presentation from a paper prepared by
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LIMITATIONS & LEVEL OF ACCURACY OF TESTS FOR ROTOMOLDING POWDERS

- Majority of materials for rotomolding use a powder format, typically “500 micron” or “35 mesh” specification
- Powder quality assessed with “Dry Flow” and “Bulk Density” tests, using a funnel & measuring cup
- Variation between tests addressed with new ARM test method, specifying tighter limits
- New test standard assumed to give improved consistency, but no data available to prove this



LIMITATIONS & LEVEL OF ACCURACY OF TESTS FOR ROTOMOLDING POWDERS

- Technical Committee of ARM produced a draft, modified by other ARMO groups & finally published as a world-wide procedure
- **Orifice dimensions tightend to $10.00\text{mm} \pm 0.01\text{mm}$, plus all other physical dimensions standardized**
- Surface roughness specified as 400 micron / 16 microinches, with sulphuric anodized blue finish
- **Ambient test temperature range specified as $20\text{-}25^{\circ}\text{C}$**
- Taps to funnel specified as not in accordance with procedure



PROJECT OUTLINE

Project Objective

*To assess accuracy & use of new “improved” methodology
Investigate suitability of Tapped Density ratios*

Experimental Materials

5 polyolefin powders, 3 ambient ground & 2 cryo ground

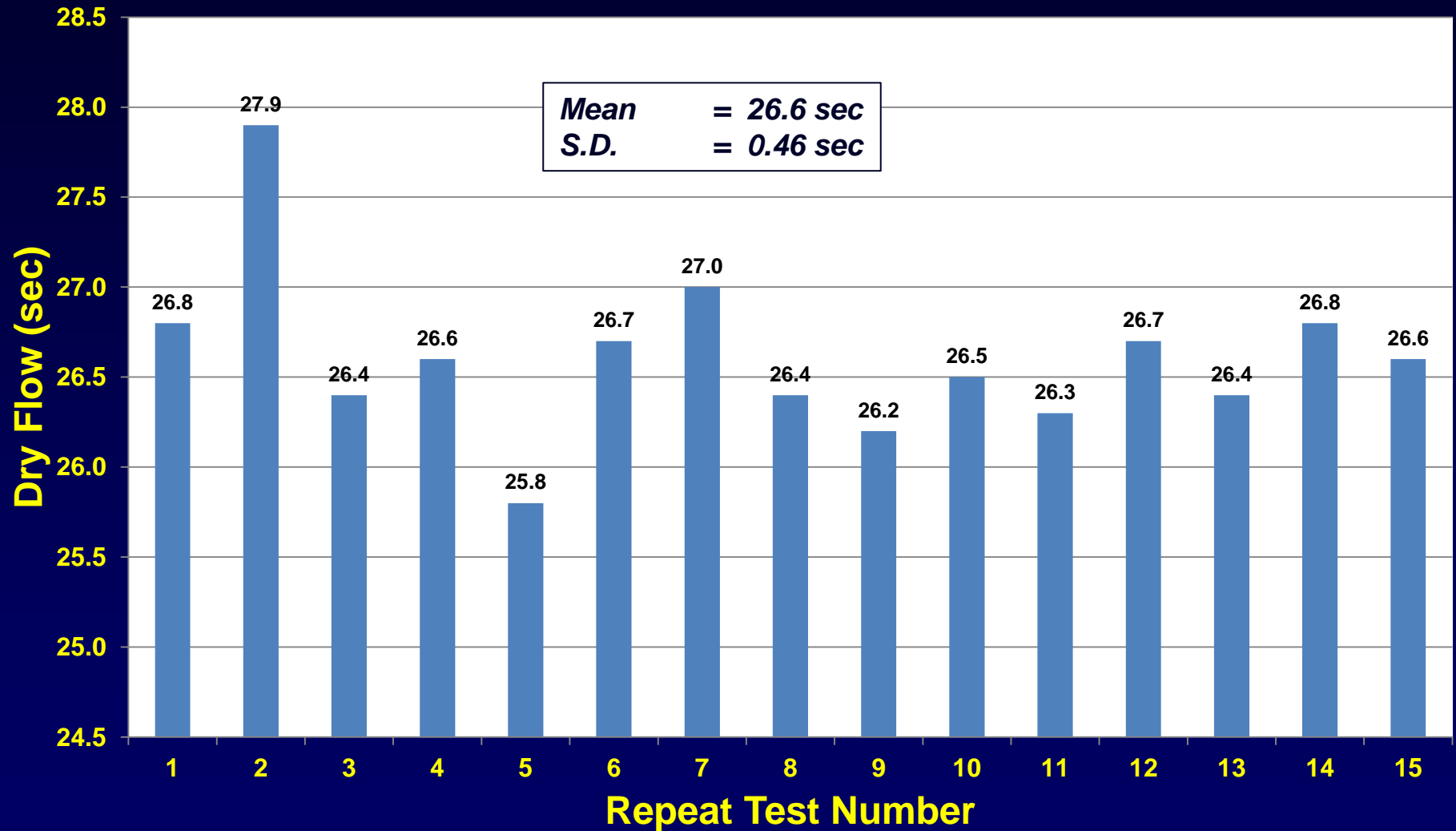
Experimental Equipment

*10 identical funnels made, to ARM / ARMO specification
Consolidation device developed for Hausner Ratio & Carr Index
4 funnels where surface roughness was progressively varied
Environmental test chamber with 20-40°C range*

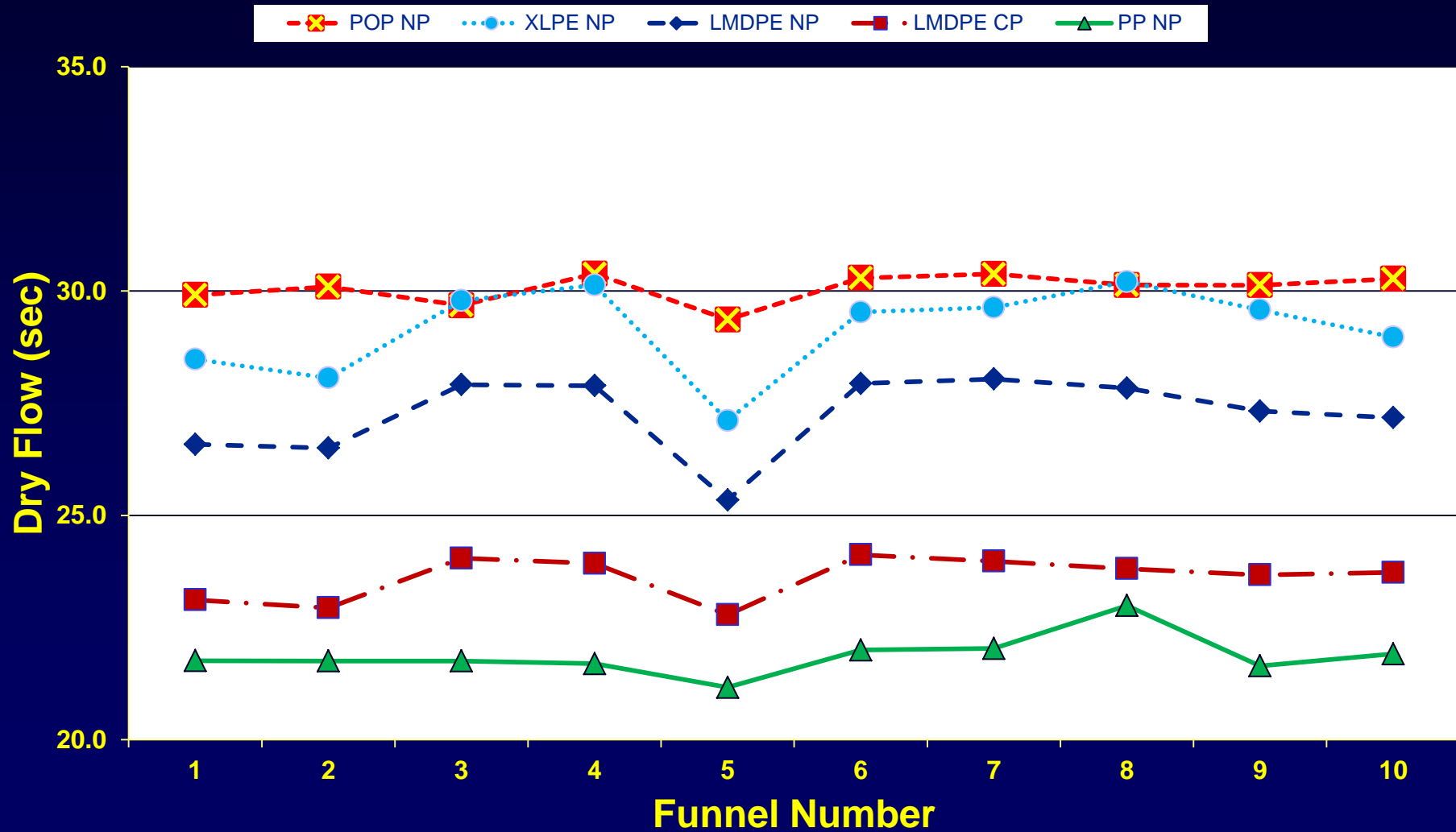
Performance Evaluation

*Dry Flow & Bulk Density measurements
Tapped Density measurements for Hausner Ratio & Carr Index*

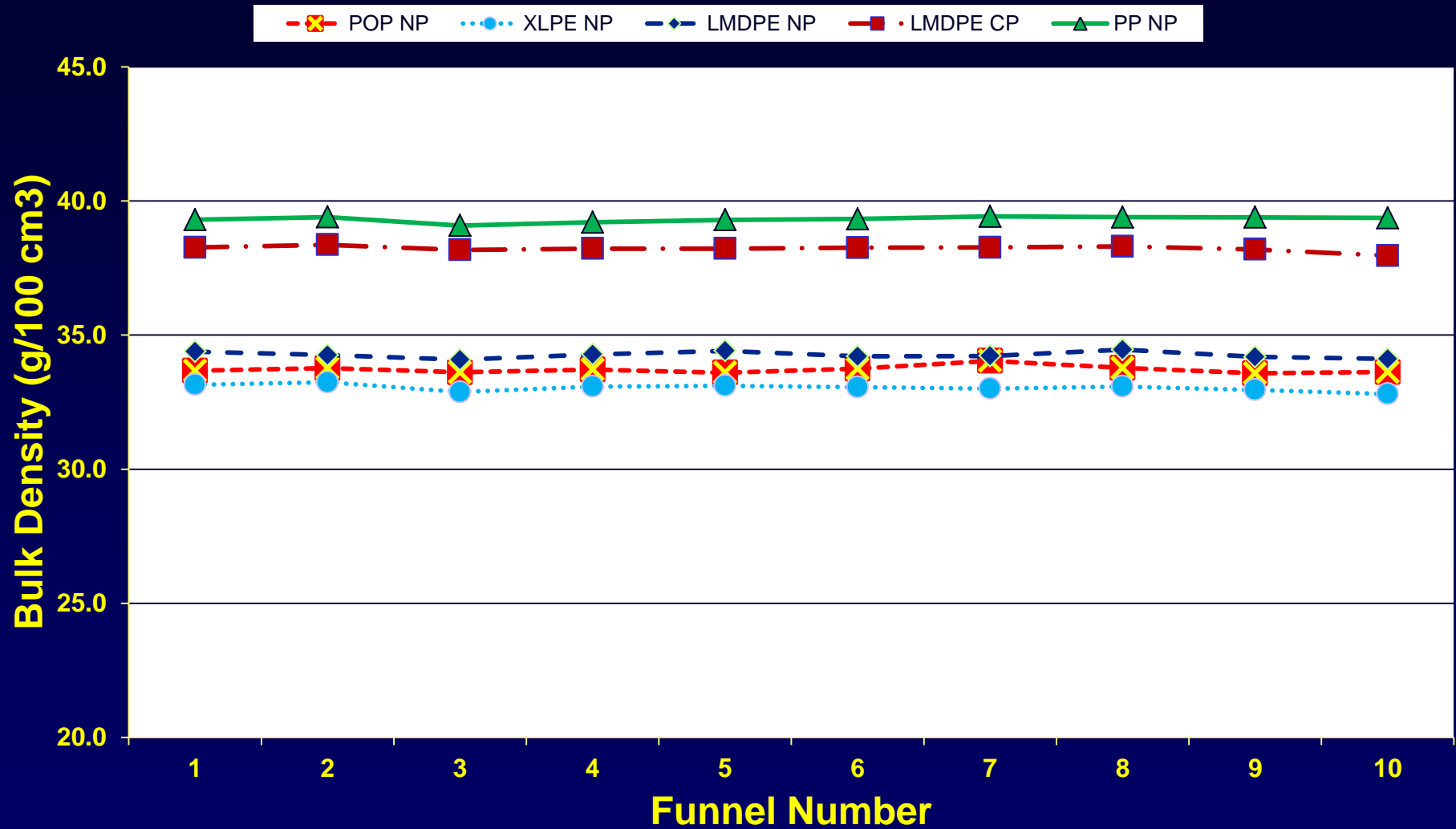
ROBUSTNESS TEST - DRY FLOW (LMDPE)



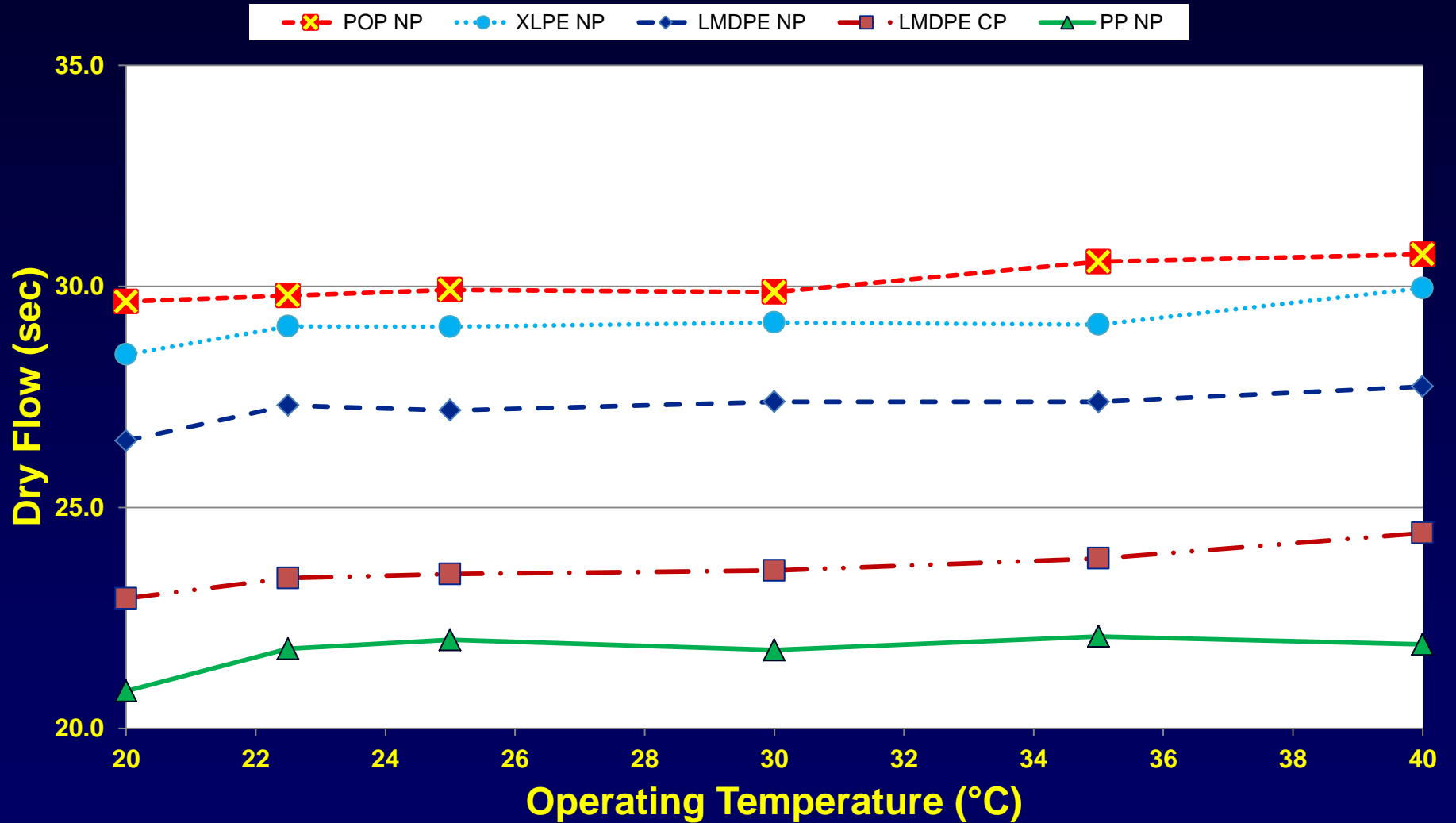
FUNNEL TO FUNNEL VARIATION - DRY FLOW



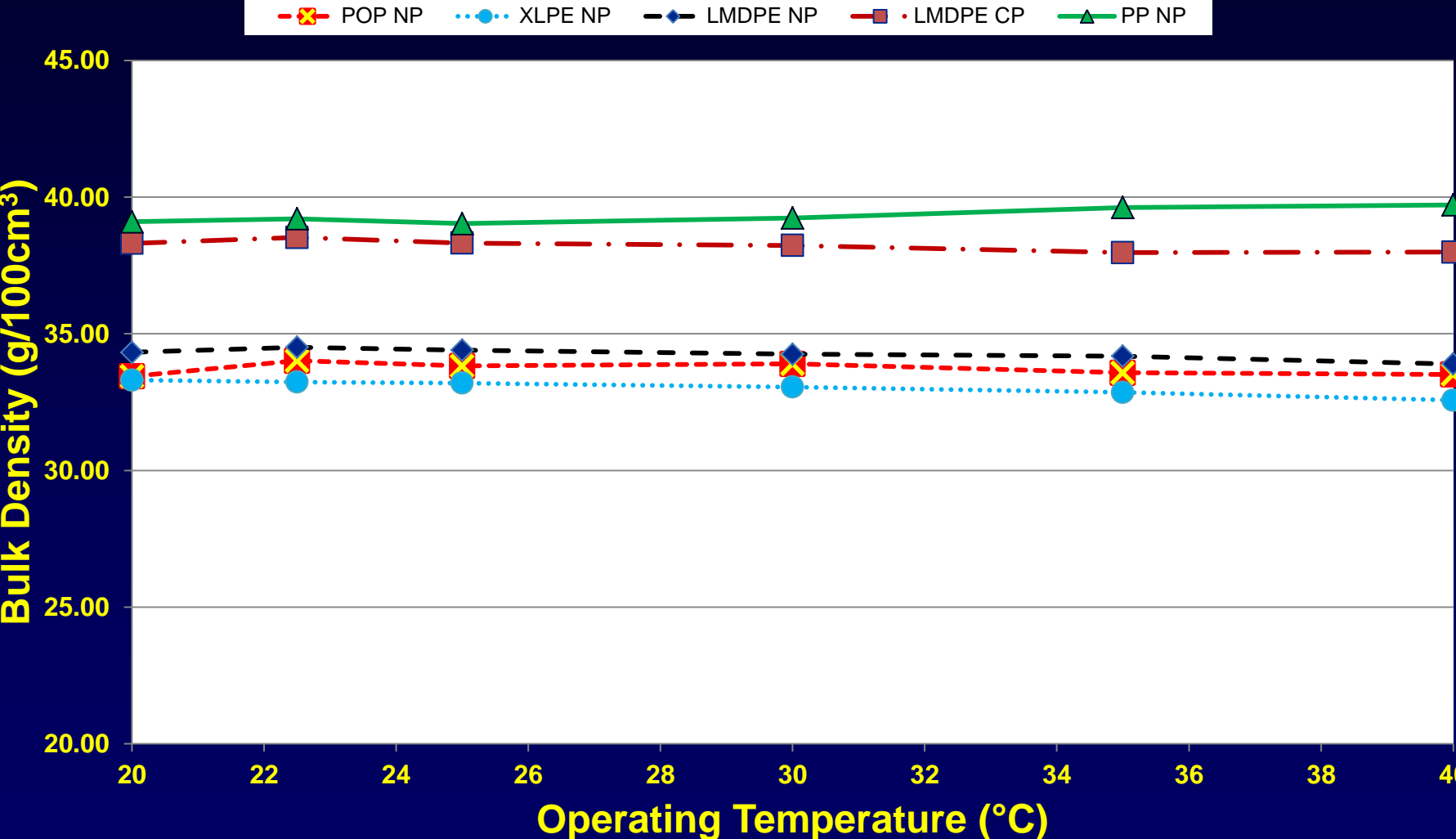
FUNNEL TO FUNNEL VARIATION - BULK DENSITY



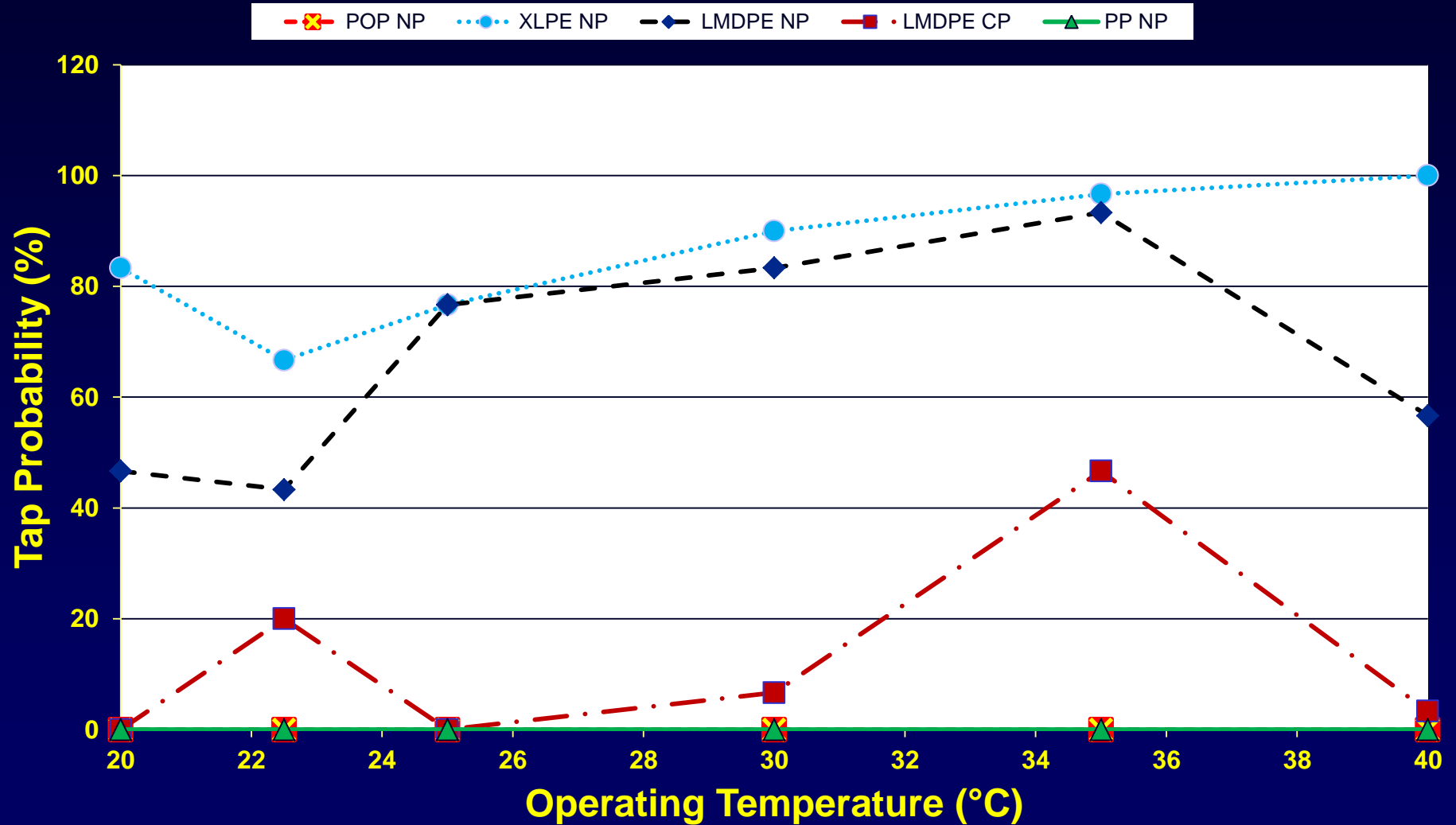
DRY FLOW VARIATION WITH AMBIENT TEMPERATURE



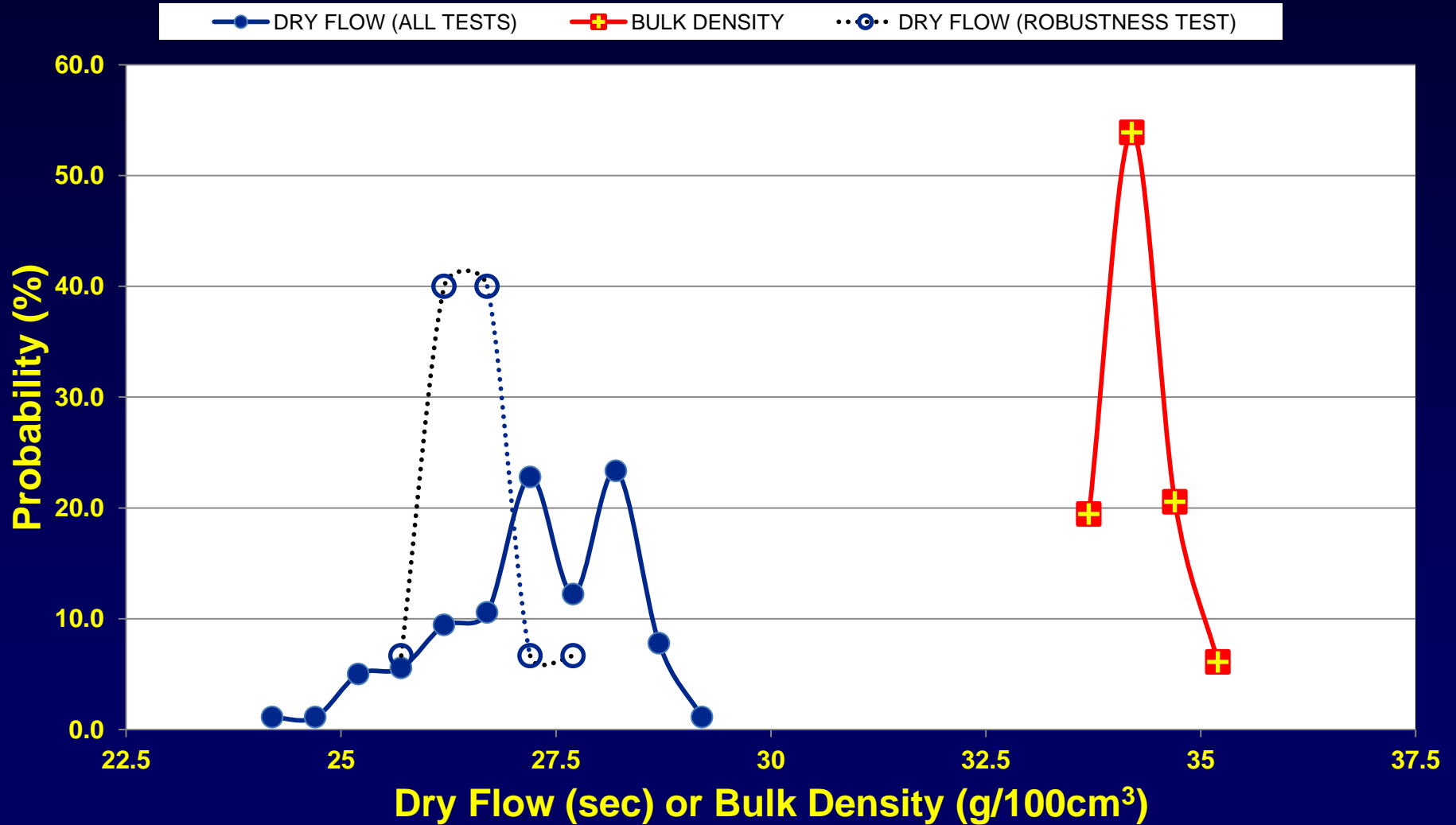
BULK DENSITY VARIATION WITH TEMPERATURE



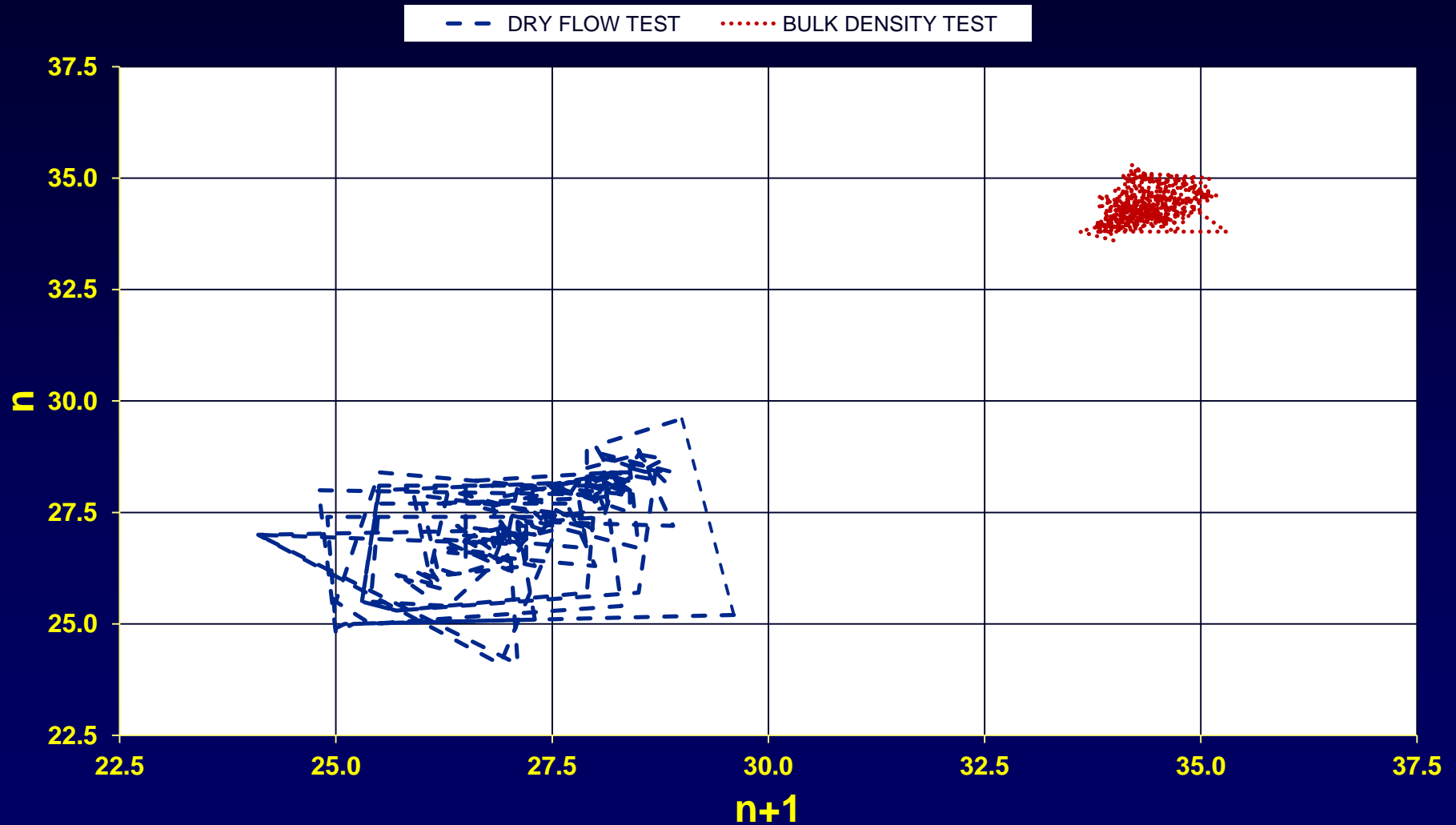
TAP PROBABILITY VARIATION WITH TEMPERATURE



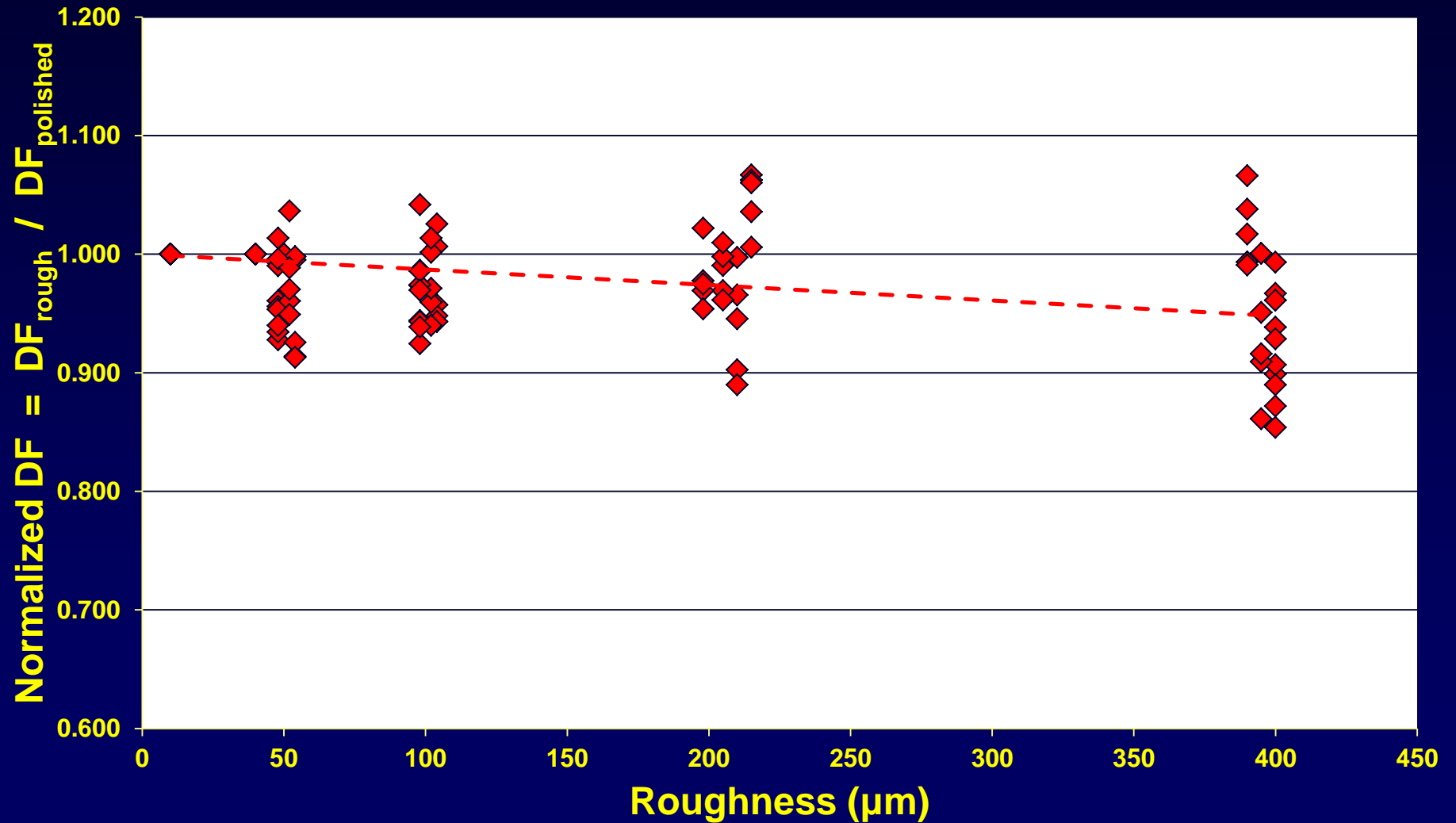
DISTRIBUTION OF DF & BD RESULTS - LMDPE POWDER



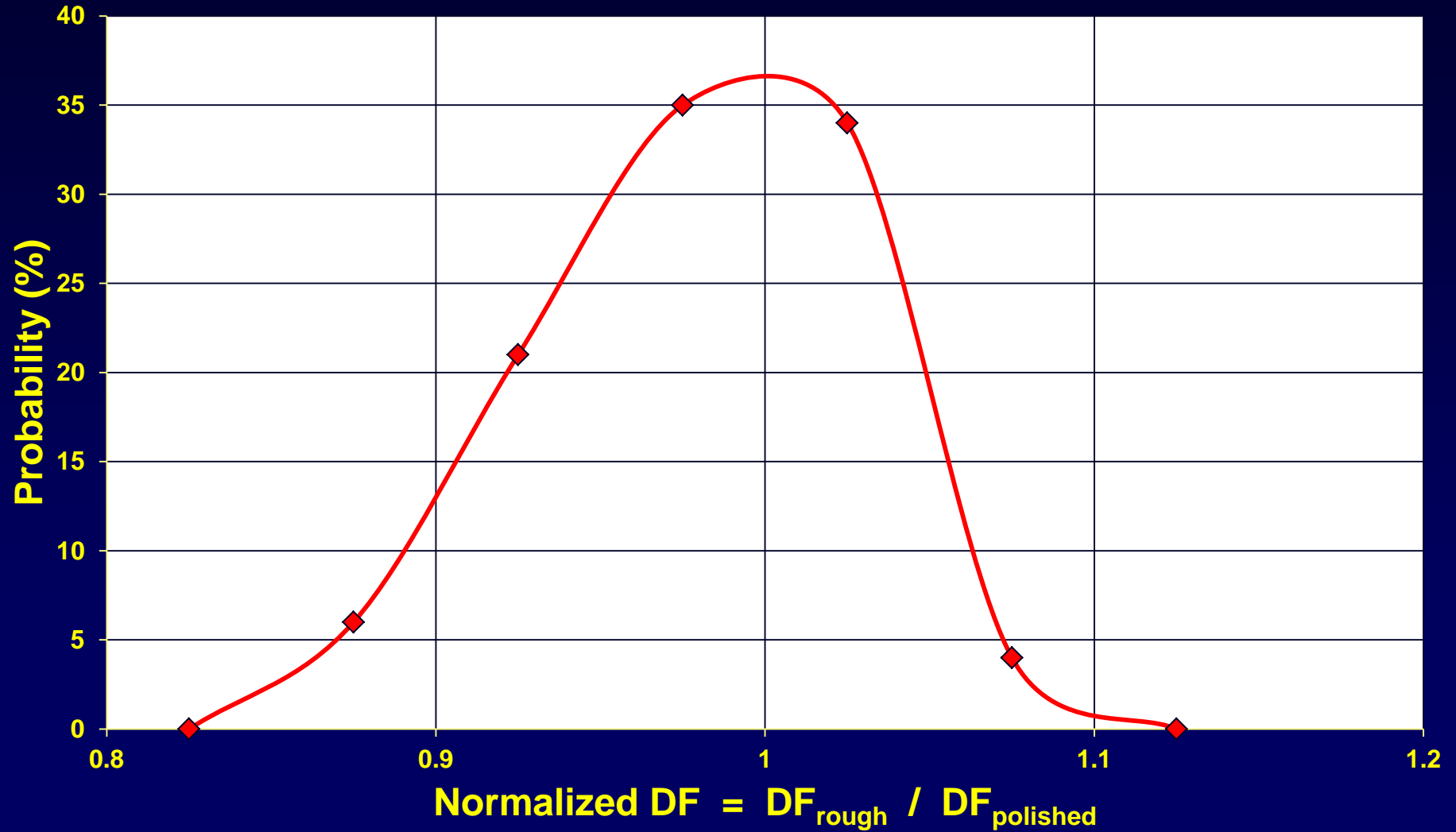
POINCARÉ MAP – LMDPE POWDER



NORMALIZED DF vs. SURFACE ROUGHNESS



NORMALIZED DF DISTRIBUTION



CONCLUDING REMARKS

Experimental Method for Dry Flow Determination

Simple & easy test to carry out

Inexplicable lack of data consistency, evidence of a chaotic system

Experimental Method for Bulk Density Determination

Simple & easy test to carry out

Data consistency is good & breadth of scatter is low

Does not differentiate well between poor and good flow powders

“Improvements” to Procedure from ARM / ARMO

No real evidence that test temperature & roughness are important

Questionable logic to imposing expensive modifications

Tapped Density measurements for Hausner Ratio & Carr Index

Does not differentiate well between poor and good flow powders