

Advanced Injection Mold Frisbee

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Introduction



- Scientific molding trials enhance efficiency for both machine parameters and part effectiveness.
- Demonstrates the intelligence capabilities of the Engel injection molding machine that are utilized in industry.
- In accommodation with the eDart system, modernized methods of receiving production analysis and quality data are possible.

Goals

- Conduct scientific molding trials using cavity pressure sensors installed in the revised 2-cavity frisbee mold.
- Investigate intelligence options and capabilities of the Engel eMotion 85-ton injection molding machine.
- Install eDart interface in cooperation with the Engel machine.
- Compare scientific molding results of Social Plastic with results of high density polyethylene.
- Develop cosmetic and dimensional processing parameters.

Engel IQ Capabilities



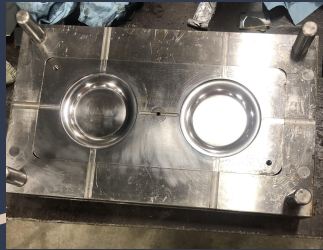
- **Industry 4.0**
 - Program capable of linking networked maintenance and production-tracking programs to the performance of the Engel.
- **Authentig**
 - Allows for live-overview of production.
 - Graphical multi-stage planning of production chain.
 - Documentation of quality measuring.
- **IQ weight control**
 - Intelligent process fluctuation compensator.
 - Controls and adapts to changes in raw materials and ambient conditions.
- **eFlomo**
 - Measures and logs important temperature control parameters of the temperature control process.

RJG eDart incorporation



- **Analog Voltage Modules:**
 - Modules within Engel control panel that provide analog readings such as injection pressure, screw stroke, and holding pressure.
- **Cavity Sensors:**
 - Modules on the top of the frisbee mold that give pressure readings from beginning of fill and end of cavity to the eDart.
- **Cycle Pressures:**
 - Shows readings of each phase of injection during a full cycle.

Mold Modifications



- Mold Polishing

- 600- and 1200-grit sandpaper used to achieve finer cosmetics in the finished part.
- WD-40 polish solution used to diminish any possibility of cosmetic defect.

- Mold Change

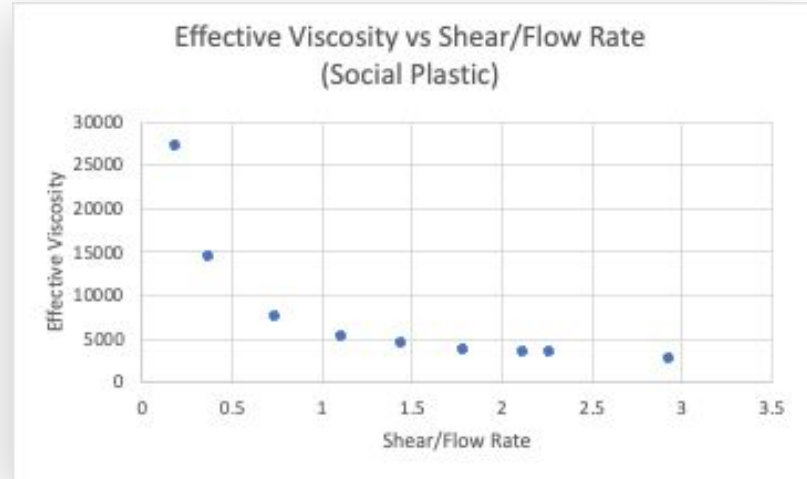
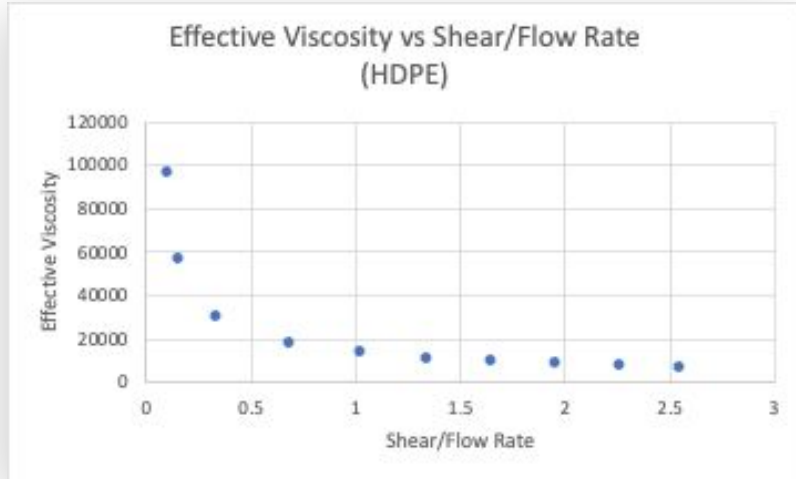
- Connected air poppets in the mold to help with ejection.
- Setup a pressure template.

Molding Trials



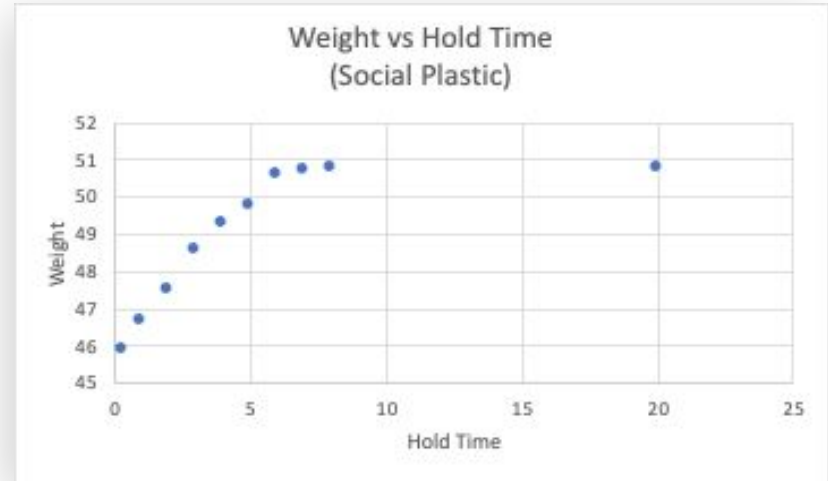
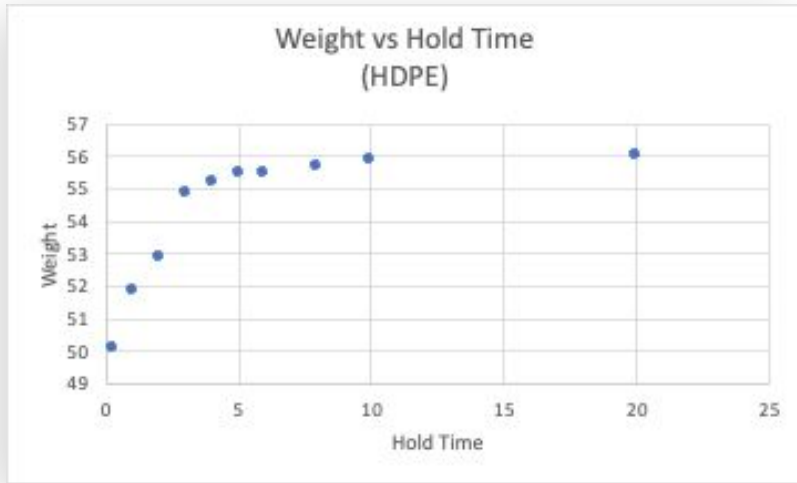
- **In-Mold Flow:** Determines optimum fill speed or injection velocity.
- **Gate Seal:** Determines the correct amount of hold time.
- **Pressure Drop:** Analyzes the injection pressure distribution within the mold and part thickness.
- **Cavity Balance:** Determines the weight arriving at each cavity during fill stage of injection and balance within the mold.

Effective Viscosity vs. Shear/Flow Rate



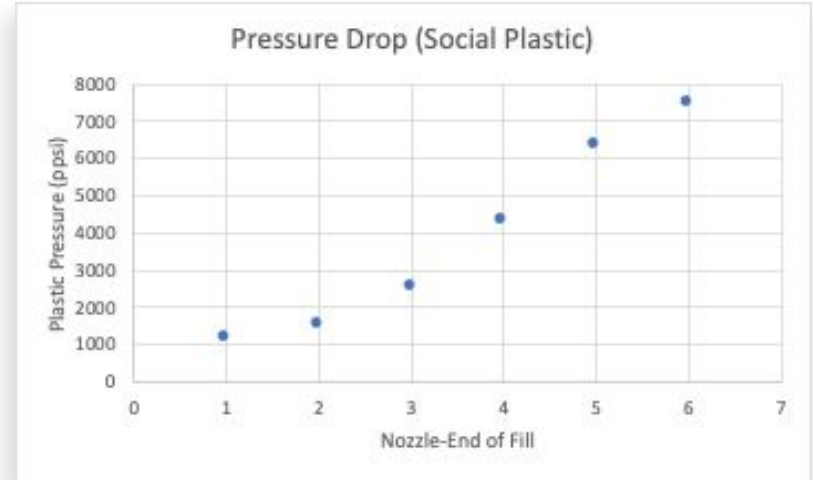
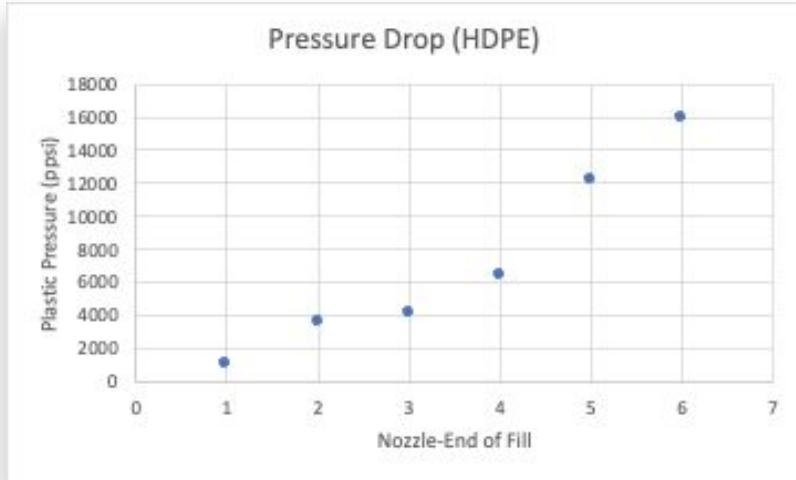
- **In-Mold Rheology:** This study shows that to achieve ideal effective viscosity of the Social Plastic requires slower fill speed than HDPE.
 - Ideal Injection Velocity of SP: **5 in/s**
 - Ideal Injection Velocity of HDPE: **6 in/s**

Gate Seal Study (Weight vs. Hold Time)



- **Gate Seal Study:** This study shows that optimum gate seal in Social Plastic requires a longer hold time than HDPE.
 - Optimum Hold Time of HDPE: **5 s**
 - Optimum Hold Time of Social Plastic: **8 s**

Pressure Drop



- Social Plastic requires significantly lower injection pressure compared to HDPE.
- This data correlates with the results of the In-Mold Rheology Study.

Cavity Balance

Material	Cavity 1	Cavity 2	Average	% Variation
HDPE	22.7 g	22.8 g	22.75 g	0.2%
Social Plastic	17.5 g	17.4 g	17.45 g	0.3%

- Both materials proved well-balanced cavities in the mold, with both having variances under 0.5%

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- Engel representatives
 - Engel troubleshooting