

# Silicone vs. TPE

---

How to Make the Right Choice

Lynn E. Momrow-Zielinski

Extreme Molding

# Overview

---

- Material attributes of Silicones and TPE's
- Processing comparison
- Typical Applications
- How to Choose
- Summary



# What are these materials?

---

- Silicones are thermoset materials with a chemical structure based on chains of alternate silicon and oxygen atoms with organic groups attached to the silicon atoms.
- $(\text{--Si--O--Si--O--})$
- TPE's are thermoplastic materials, sometimes referred to as thermoplastic rubbers, that are a class of copolymers that are a mix of polymers (usually a plastic and a rubber)
- TPE's, TPU's, TPV's

# Silicone Properties

---

- Hypoallergenic
- Temperature resistance on the high and low end (continuous use -100F to 350F)
- Good to excellent chemical resistance to oils, solvents and other chemicals
- UV resistant for excellent weatherability
- Soft and flexible
- Resistant to a permanent set (low compression set)
- Electrical insulation, vibration dampening

# TPE Properties

---

- Rubbery soft touch feel
- Flexible
- Shock absorbing
- Okay weathering and chemical resistance
- Resistant to Ozone
- High Elasticity
- Can be recycled
- Retains properties at room temperature



# TPE's vs. Silicones

---

## TPE's

- Soft flexible elastomers
- Room Temperature Range
- Readily bondable to select plastics (PC, PP, ABS)
- Can be recycled

## Silicones

- Soft flexible elastomers
- Broad Temperature range
- Bonding is a problem
- Cannot be recycled
- Highest market acceptability in medical and food use applications

# TPE Claim to Fame

---

- TPE's are a unique class of engineering materials combining the look, feel and elasticity of conventional thermoset rubber with the processing efficiency of plastics (British Plastics Federation website).

# Silicones Claim to Fame

---

- Silicones are elastomeric materials with a gold standard reputation for safety in human contact applications. They are also an unbeatable material in automotive applications due to their good heat resistance, excellent oil resistance and superior damping and sealing characteristics.



# TPE vs. Silicone Processing

---

## TPE's

- Usually fully compounded by the supplier
- Pellet form – somewhat soft and rubbery feel
- Fed into a traditional plastics hopper
- Colorant is either compounded in or salt and pepper blended at the machine
- Injection molded

## Silicones

- LSR or LIM is 50-50 ratio A to B in honey like consistency in pails or drums
- Fed into the barrel using accurate expensive metering pumps
- Colorant is 3<sup>rd</sup> stream add in viscous liquid form
- Injection and Compression Transfer molded

# Molding Differences

---

- Silicone is kept chilled during transport through the barrel and is injected into a hot mold (270-450F)
- TPE is transported along a hot barrel where it gets melted and is injected into a room temperature range mold (70-120F)
- TPE's and silicones both mold at low injection pressures typically < 1000 psi
- Silicone cycle times are often a bit longer than TPE's due to cure mechanisms
- Silicone flashes easier than TPE, silicone molds are more complicated and expensive
- TPE's shrink like plastics causing sink, silicone thermally expands overfilling the cavity causing backrind
- Silicone has a 2-3 day potlife which must be dealt with, TPE you just re-heat and melt
- Similar elastomeric ability to pull from undercuts
- If make a mistake, TPE can be recycled and silicone is landfilled

# Overmolding Differences

---

- TPE will bond to many plastic substrates, standard silicone will not
  - PC, PP, ABS and blends
- First shots often must be preheated with silicone, not necessary with TPE
- High mold temperatures with silicone cause many plastic substrates to soften and deform or even melt



# Typical Consumer Applications

---

## TPE

- Fitbit band
- Soft phone cases
- Foot cushions
- Soft touch grips
- Toys

## Silicone

- Spatulas, baking liners, pot holders
- Teethers (Baby Banana Brush)
- Pacifiers
- Infant dinnerware
- Higher end soft phone and tablet cases

# How To Choose?

---

- Pricing for FDA and Class VI compliant grades of silicone and TPE are very comparable → Non factor
- Silicone is still the gold standard in body contact applications
- Silicone is a must in higher heat applications like baking, industrial dishwasher use
- If you are looking to overmold over a plastic substrate, TPE would definitely be preferable
- More molders will be competent at TPE than silicone → though TPE is definitely a subspecialty of plastics molding
- As a consumer, you may not be able to tell the difference

# Summary

---

- TPE's and silicones are both soft flexible rubbery materials
- Silicones like it hot, TPE's not so much
- Silicones are universally accepted in the health care and food use arenas
- Silicone remains the material of choice where compression set resistance is key
- TPE's are more forgiving to process → if you screw up you can regrind them, they bond to things, molds are at room temperature making them safer for production operators, they usually have a cycle time advantage
- Material pricing is comparable so often it comes down to marketing acceptance/advantage and temperature of use