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XIAMETER
from DOW CORNING

Five Myths About Silicone-based Additives for Plastics: Busted!

Shawn Mealey
Senior Industry Specialist

DOW CORNING

We help you invent the future.™

What you may discover today

- There are new silicone-based tools for your *plastics additives toolbox*
- Silicones come in many different forms
- Silicones can be much more than just processing aids
- Silicones are cost-effective
- Printable, paintable surfaces are possible in molded-in-color plastic with the right silicone additives

Dow Corning is . . .

- A global leader in silicones and high-purity silicon
  - 7,000 products/services
  - 25,000 customers
  - 11,000 employees
  - $6.2 billion sales 2014
- Focused on sustainability and *Responsible Care*®
- Equally owned by The Dow Chemical Company and Corning, Incorporated
- Founded in 1943

Dow Corning in the Plastics Additives Market

We simplify access to the uniqueness of silicone technology, from liquids to pellets.

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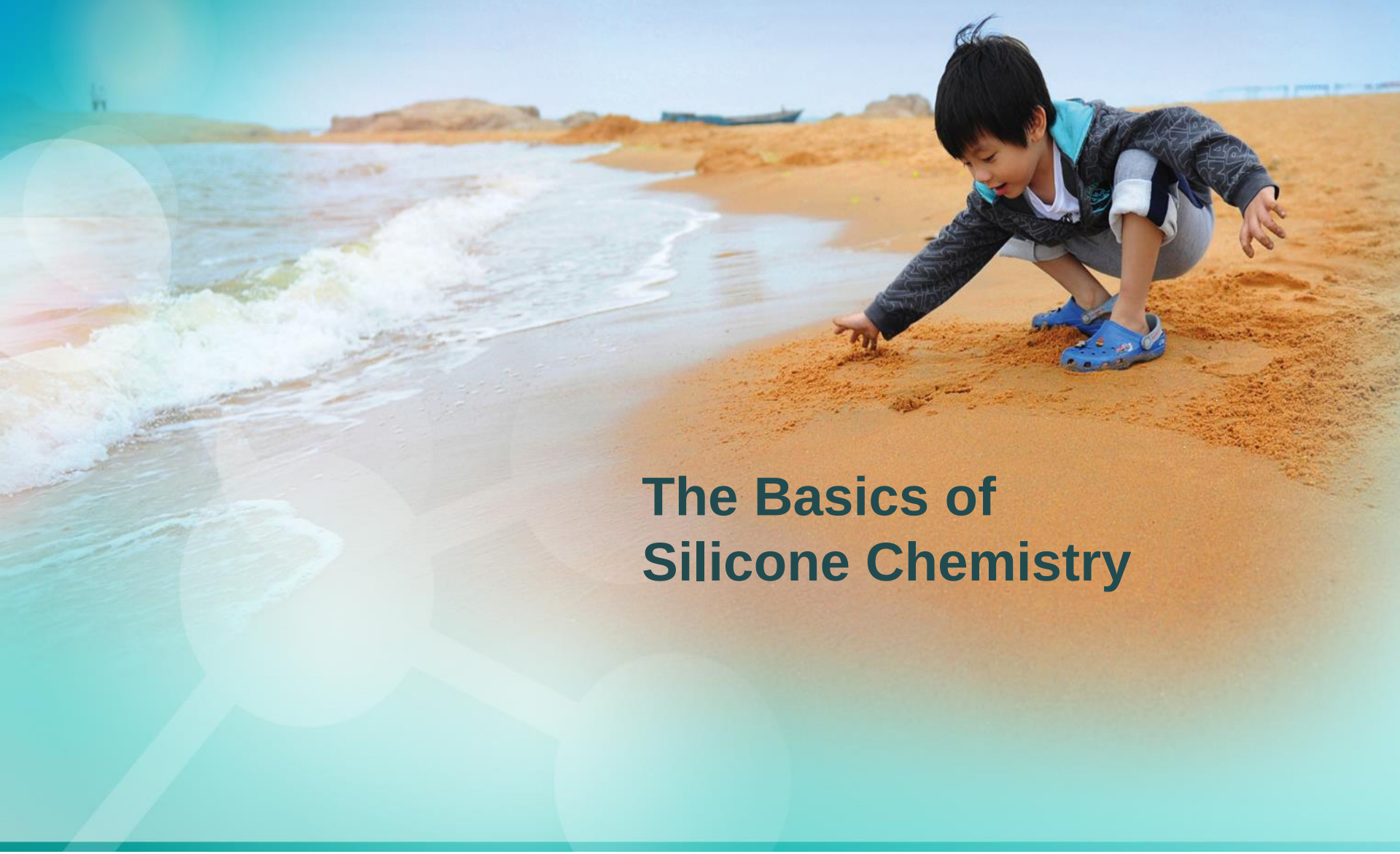
We help you invent the future.™

Agenda

- The Basics of Silicone Chemistry
- Five Silicone Myths Busted
- When and How to Evaluate Silicon-based Additives



The Basics of Silicone Chemistry

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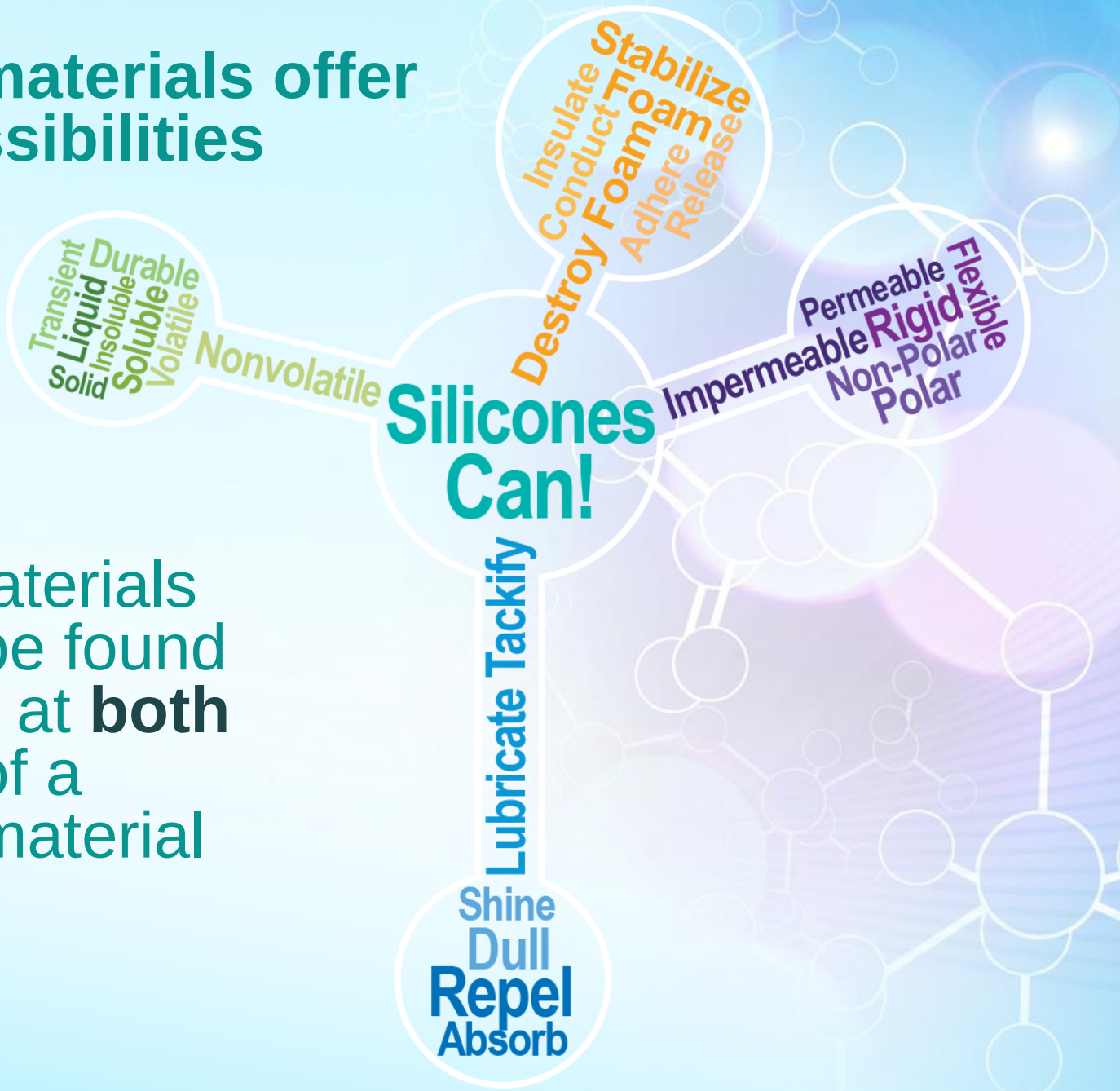
Silicone materials offer many possibilities



Silicone materials can often be found performing at **both** extremes of a particular material property

Silicone materials exhibit a unique combination of material properties

- Long-term elasticity, pliability and flexibility
- Stability/durability under challenging conditions such as extreme high or low temperatures, chemicals and oxidation
- Weather resistance
- Resistance to aging
- Inertness or organo-functional affinity
- Water repellency, good wetting and flow
- Strong adhesion properties or low coefficient of friction
- Excellent dielectric properties

Silicone brings multiple benefits to plastic materials and processing

REINFORCE

Reinforce mechanical properties, filler incorporation and compatibility of formulations.

EXTEND

Extend physical properties such as impact resistance, flame-retardant performance and quality of light diffusion.

ENHANCE

Increase throughput and productivity. Reduce energy costs. Improve filling of intricate details and mold release..

Five Myths about Silicone: Busted

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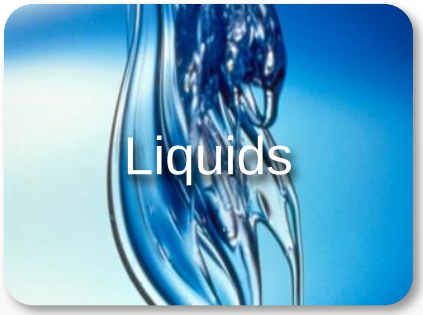
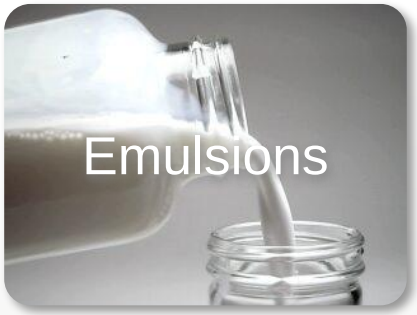
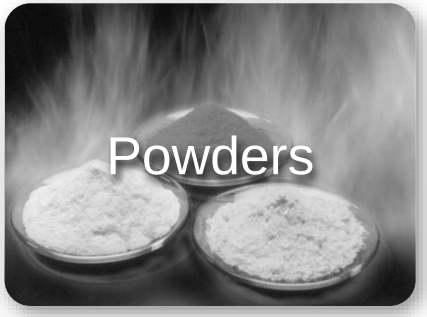
Myth 1: Silicones are only available as liquids

- It's TRUE that the most common form of silicones is as liquids
- BUT, siloxane chemistry is quite versatile and can be arranged and combined to form liquids to solids and forms in between

Silicones come in many forms



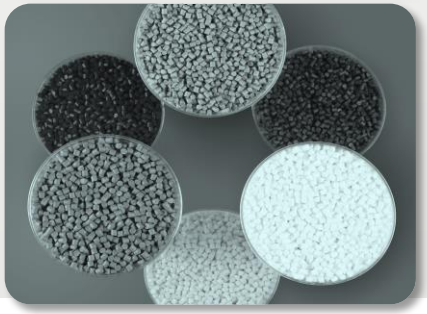




Product line-up for FR applications

- *Dow Corning*® 11-100 Additive
- *Dow Corning*® 40-001 Additive

- *Dow Corning*® 4-7081 Resin Modifier
- *Dow Corning*® 4-7105 Resin Modifier



- *Dow Corning*® MB50-801 Siloxane Masterbatch
- *Dow Corning*® MB50-802 Siloxane Masterbatch
- *Dow Corning*® MB50-811 Siloxane Masterbatch
- *Dow Corning*® 24-213 Additive

Myth 2: Silicones are just processing aids

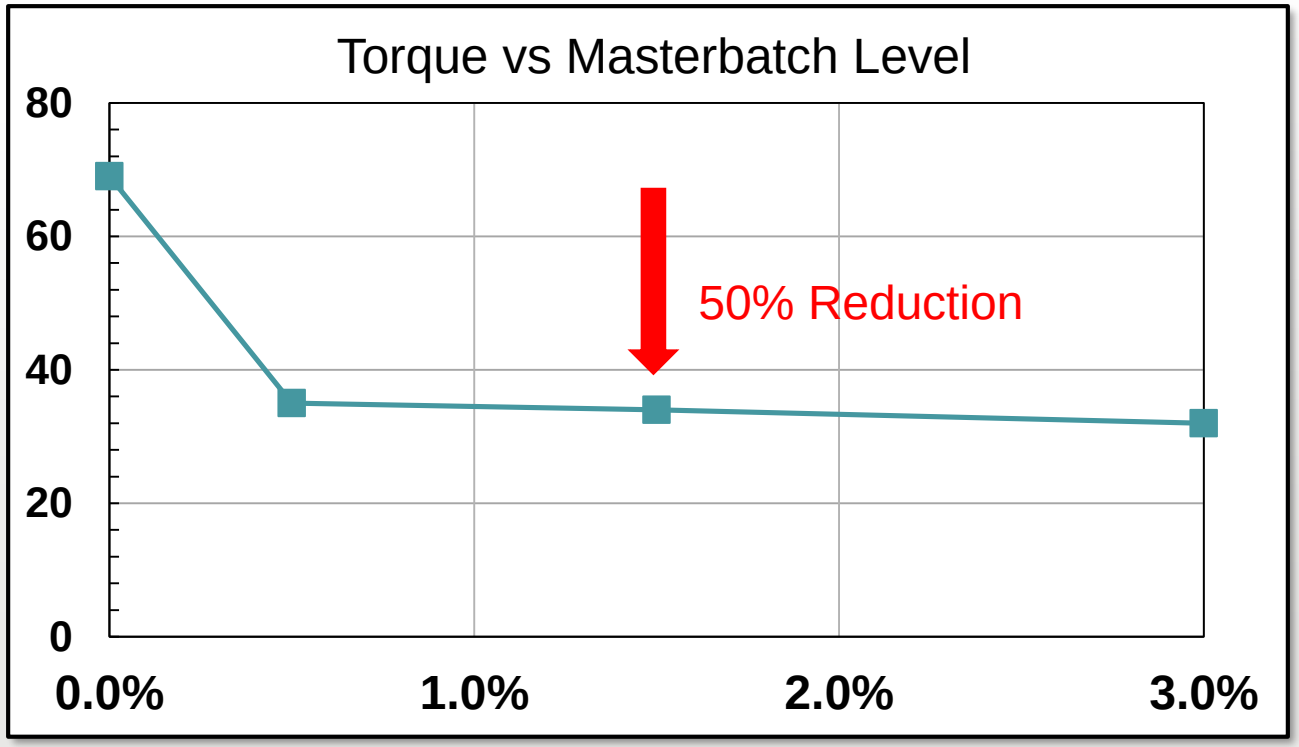
This is TRUE…to an extent

- Extruder torque reduction
- Extruder throughput increase
- Lower energy consumption
- Die or plate build-up reduction
- Filler dispersion
- Extrudate quality
- Film slip improvement
- Mold release
- Improved flow into mold
- Reinforcement wetting
- Polymer crosslinking

Myth 2: Silicones are just processing aids

This is TRUE…to an extent

- Extruder torque reduction with *Dow Corning*® MB50-002 Masterbatch



Myth 2: Silicones are just processing aids

This is TRUE…to an extent

- Die or plate build-up reduction

Control (no additive)

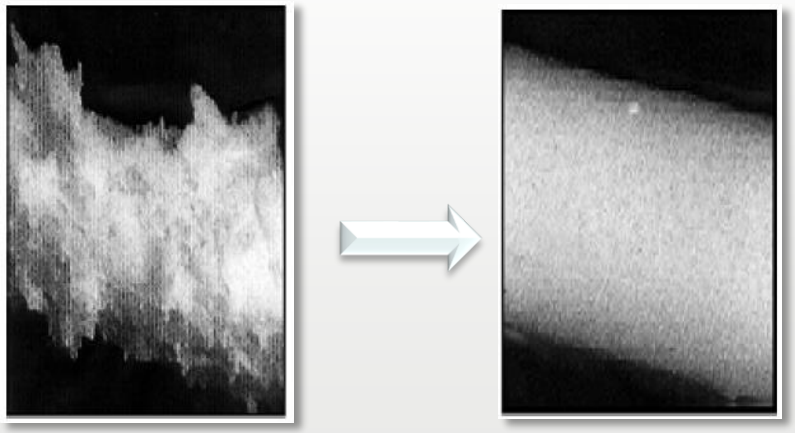
***Dow Corning*® 4-7081 Resin Modifier**

Myth 2: Silicones are just processing aids

This is TRUE…to an extent

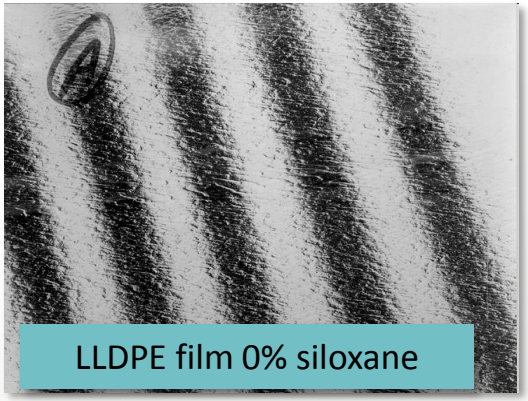
- Extrudate quality

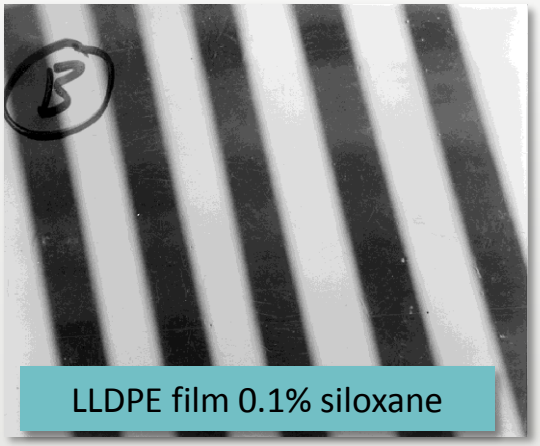
Effect of SiMB on extrudate quality



No additive

3% *Dow Corning*® MB50-002 Masterbatch

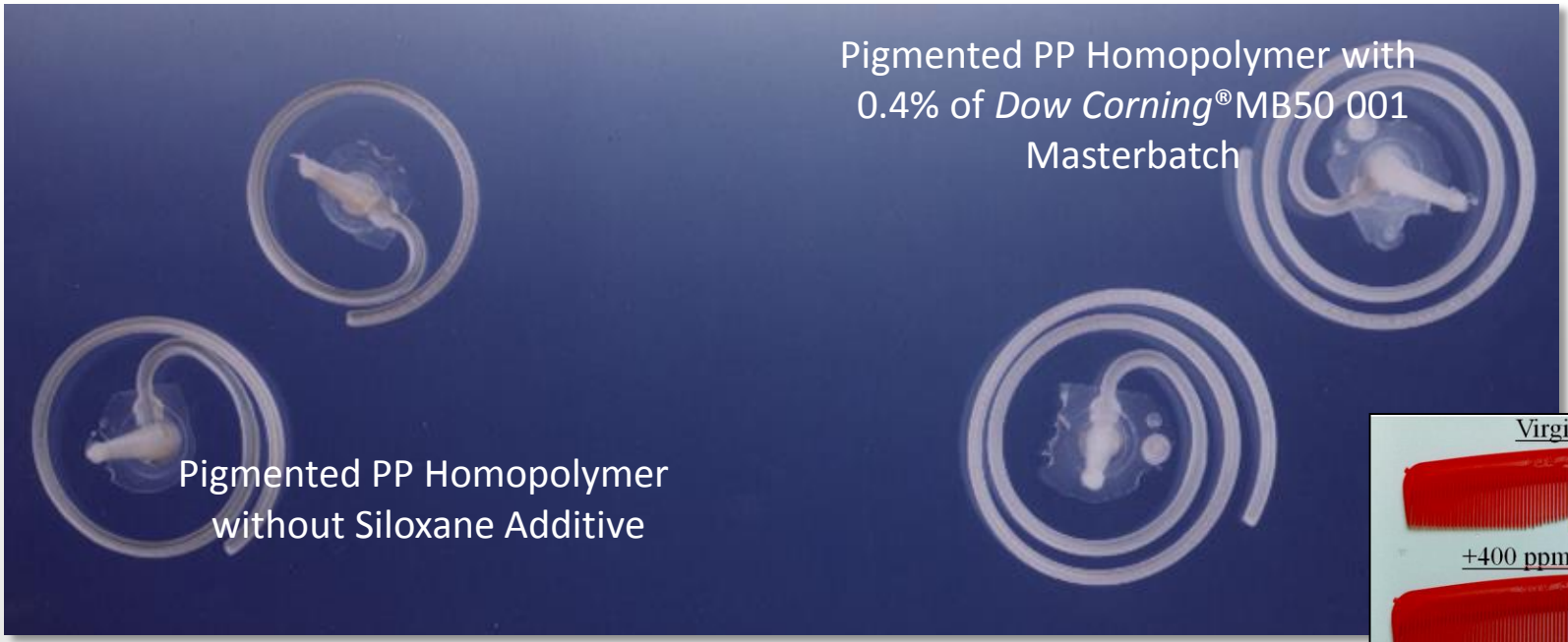


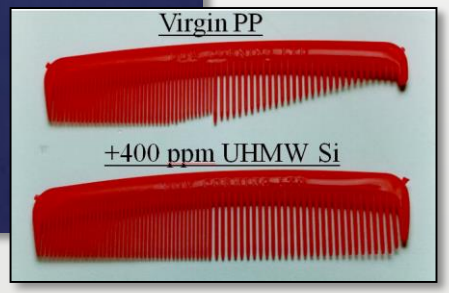


Myth 2: Silicones are just processing aids

This is TRUE…to an extent

- Improved flow into mold





Silicones also enhance physical properties

For Thermoplastic Compounds

- Lower coefficient of friction *(increased slip)*
- Surface look and feel modification
- Surface durability & quality *(Anti-Scratch without Tackiness)*
- VOC reduction *(replacement of more volatile components)*
- Fire retardant *(FR synergist)*
- Impact modifier
- Hydrophobicity
- Light diffusion

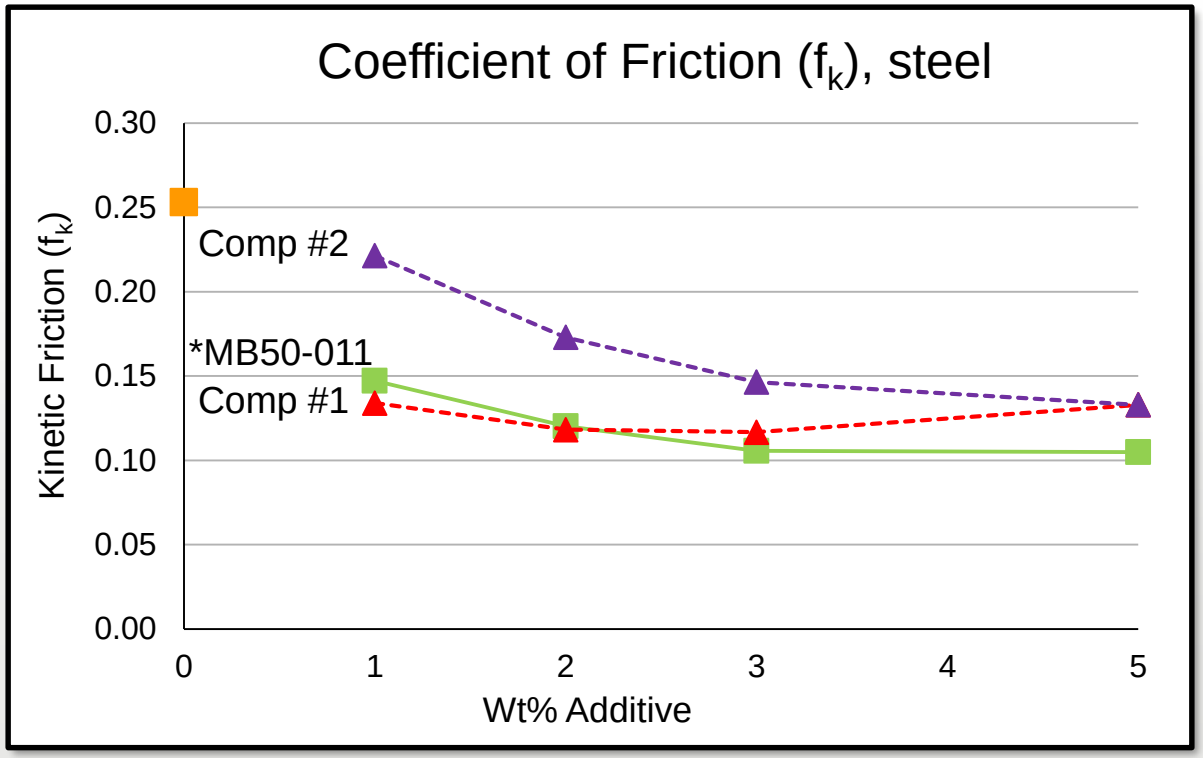
For Reinforcing Materials and Fillers

- Filler dispersion improvement *(dispersion within the compound)*
- Compatibility improvement *(between compound components)*
- Adhesion between ingredients *(between dissimilar materials)*
- Hydrophobic property increase

Silicones also enhance physical properties

For Thermoplastic Compounds

- Lower coefficient of friction *(increased slip). *Dow Corning®* MB50-011 Masterbatch



Silicones also enhance physical properties

For Thermoplastic Compounds

- Surface durability & quality *(Anti-Scratch without Tackiness)*

Percent *Dow Corning*® MB50-011 Masterbatch in talc/PP

0%

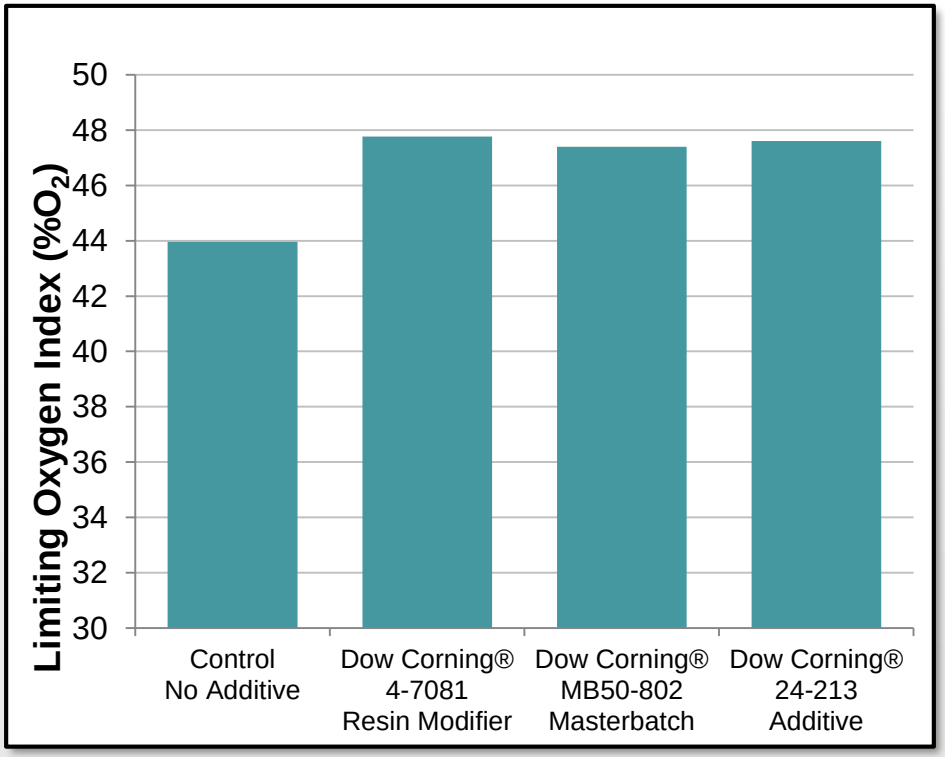
1%

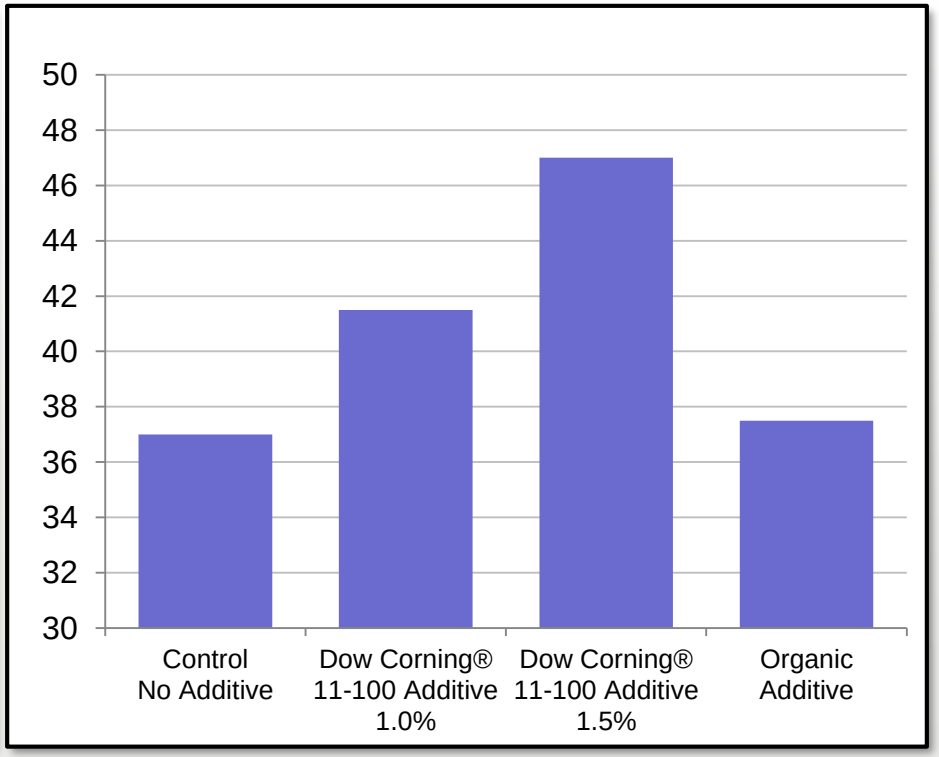
2%

Silicones also enhance physical properties

For Thermoplastic Compounds

- Fire retardant *(FR synergist)*

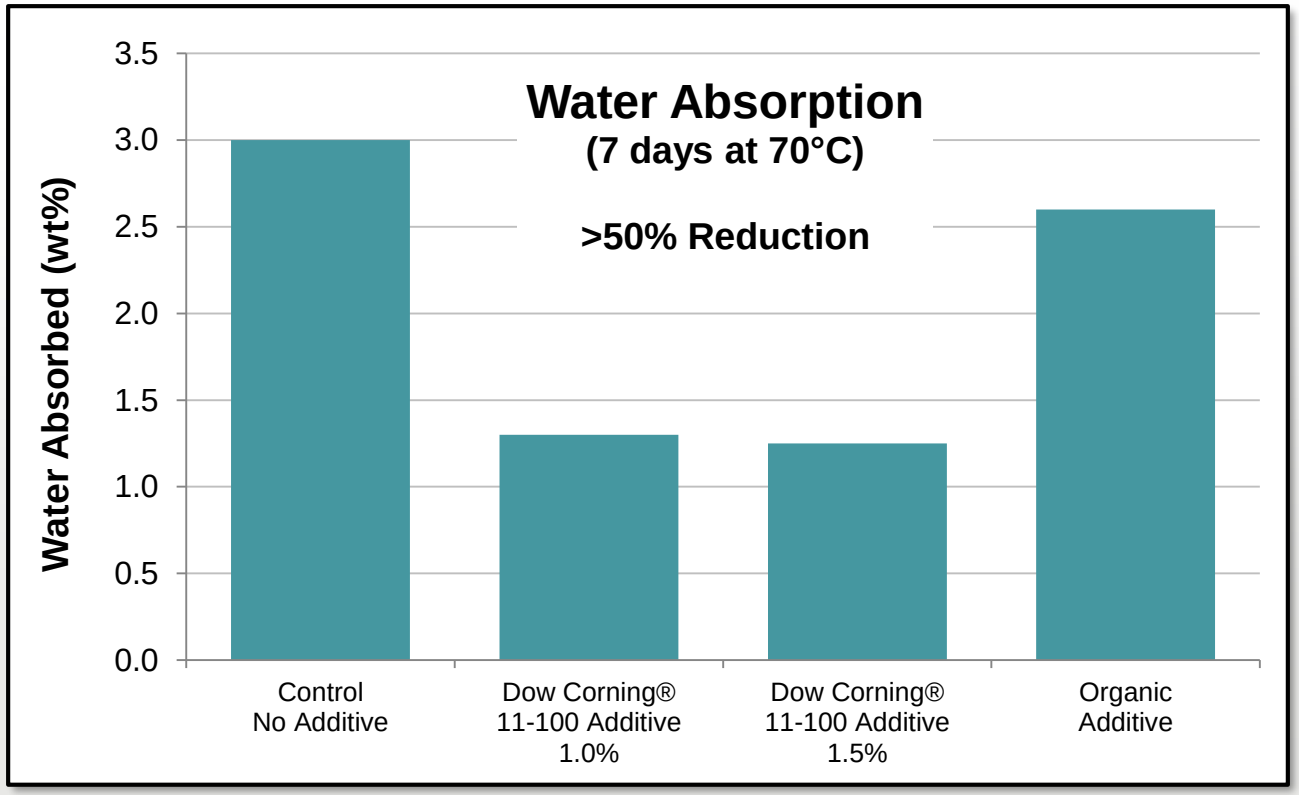




Silicones also enhance physical properties

For Thermoplastic Compounds

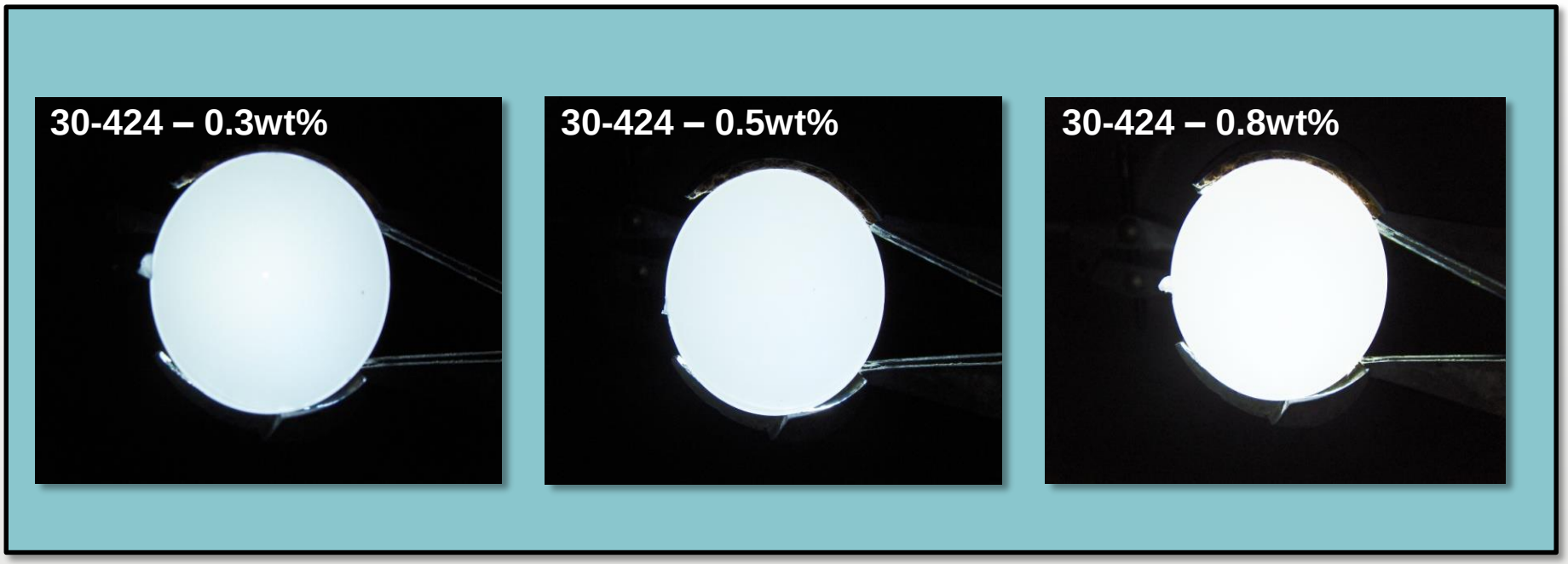
- Hydrophobicity



Silicones also enhance physical properties

For Thermoplastic Compounds, *Dow Corning*® 30-424 Additive

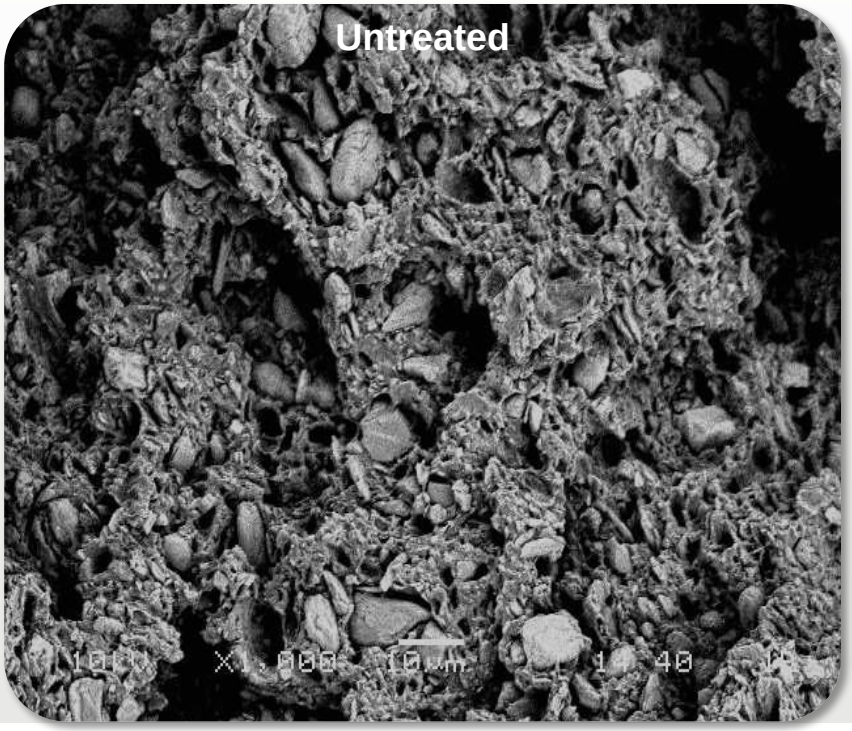
- Light diffusion

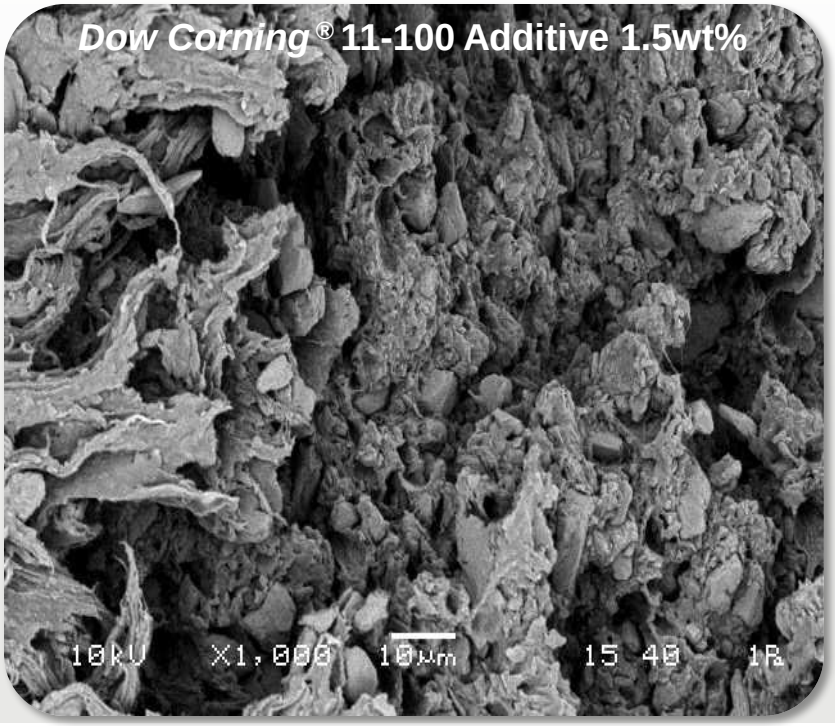


Silicones also enhance physical properties

For Reinforcing Materials and Fillers

- Filler dispersion improvement *(dispersion within the compound)*
- Compatibility improvement *(between compound components)*

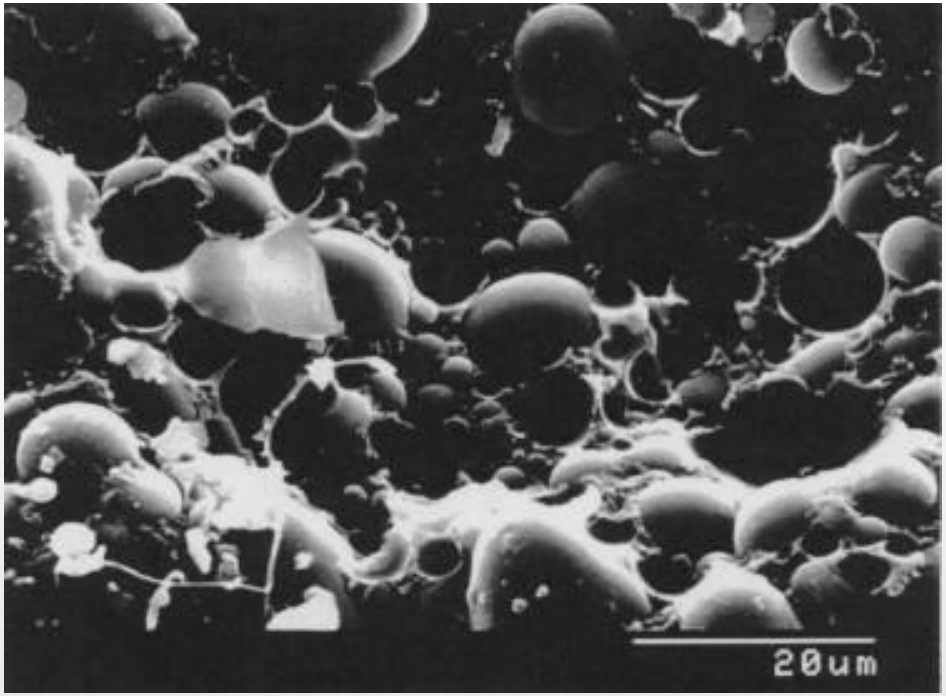


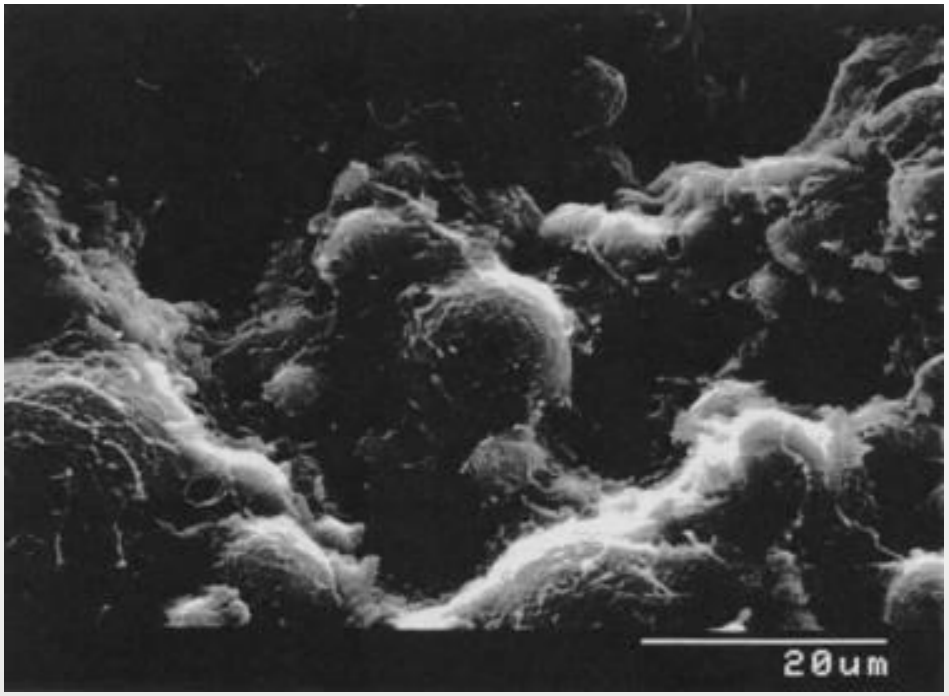


Silicones also enhance physical properties

For Reinforcing Materials and Fillers

- Adhesion between ingredients *(between dissimilar materials)*





Without silane

With silane

Silica filled epoxy resin

Myth 3: There aren't any new silicone additives

- Silicone fluids – 1950's
- Organofunctional Alkoxysilanes – 1960's
- Ultra-High Molecular Weight Siloxane Masterbatch – 1990's

Myth 3: There aren't any new silicone additives

- *Dow Corning*® 24-213 Additive ➔ Functional masterbatch
- *Dow Corning*® 31-441 Additive ➔ Silicone-polyamide copolymer
- *Dow Corning*® 40-001 Additive ➔ Phenyl containing silicone

Myth 3: There aren't any new silicone additives

- *Dow Corning*® 24-213 Additive ➔ Functional masterbatch

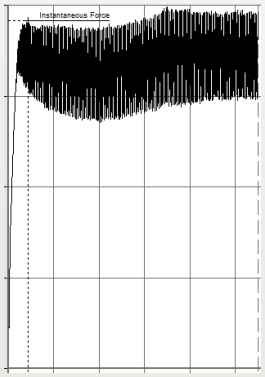
Features	Benefits
Unique silicone composition	Lower torque and significantly lower die drool while maintaining tensile and elongation
Halogen-free flame retardant	Provides a high limiting oxygen index (LOI), lower heat release, smoke and CO evolution without halogens
Functionalized siloxane system	Helps to maintain physical properties of compound
Lower water absorption	Better conductivity in wire and cable applications
Designed for EVA/PE compounds	LLDPE carrier resin useful in olefins, including highly-filled EVA and PE systems
Easy-to-use pellet form	Easier handling/blending for production
Multifunctional	Can replace existing additives that have offered single benefits

Myth 3: There aren't any new silicone additives

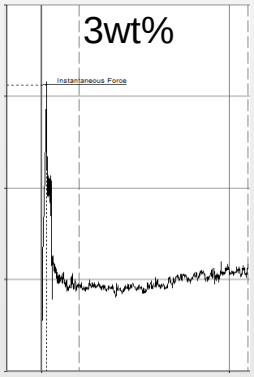
- *Dow Corning*® 31-441 Additive ➔ Silicone-polyamide copolymer

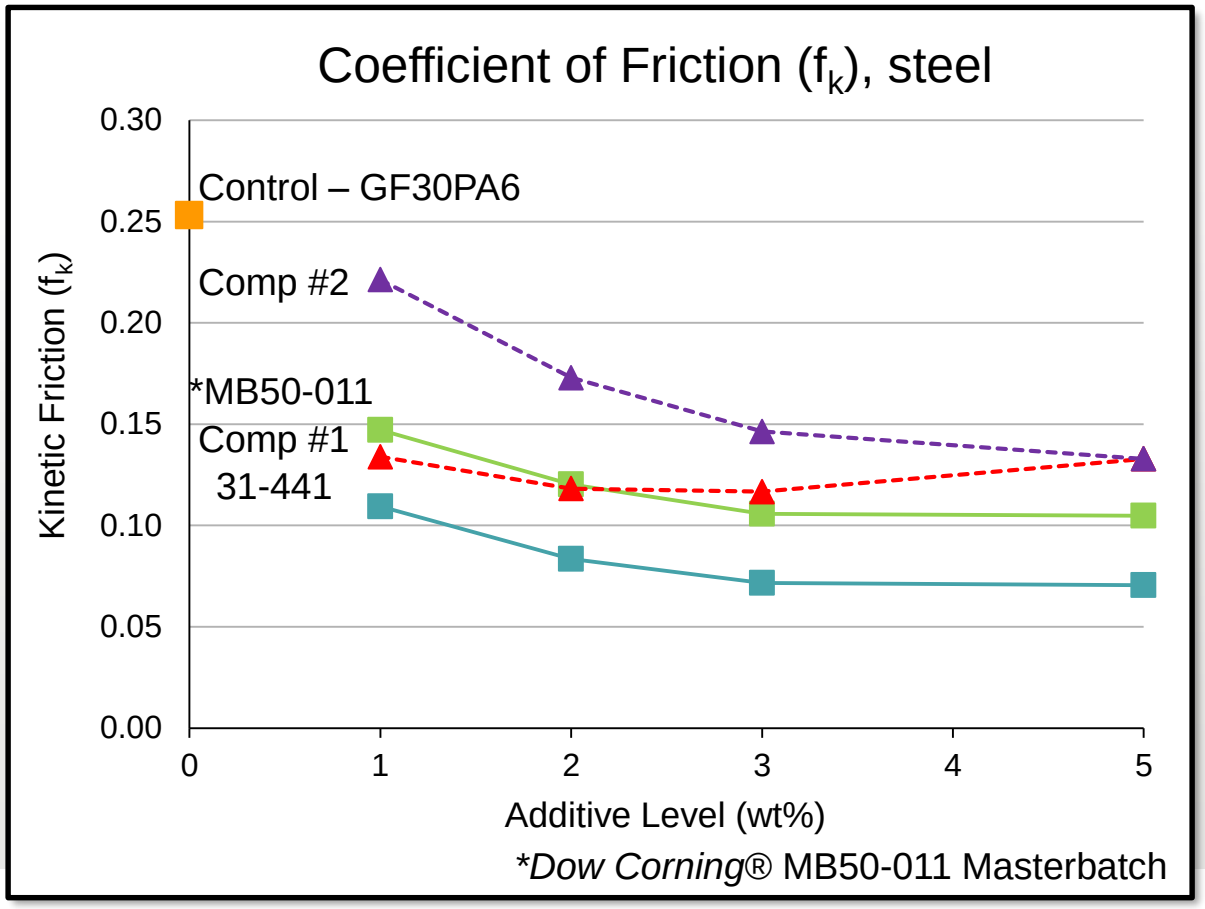
Significant reduction in slip-stick

Control
GF30PA6



Dow Corning®
31-441 Additive
3wt%

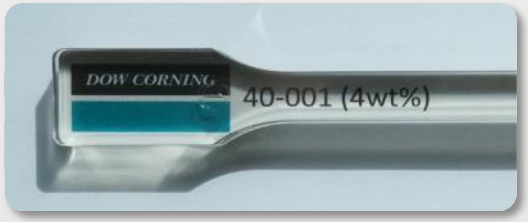




Myth 3: There aren't any new silicone additives

- *Dow Corning*® 40-001 Additive ➔ Phenyl containing silicone

	UL94 1.5mm	UL94 1mm	Tt	Haze	E-Mod (MPa)	Fmax (MPa)	Notched IZOD (kJ/m2)
			1.5 mm optical disks		ISO 527 T2		ISO 180
Reference (PC MFI 10.5)	V2	V2	89%	0.5%	2400	64	11
KSS/PTFE (0.6/0.3wt%)	V0	V0	82%	13.3%	2320	63	10
40-001 2wt%	V0	-	88%	1.4%	2350	65	8.1
40-001 4wt%	V0	V0	87%	1.8%	2390	67	6.5



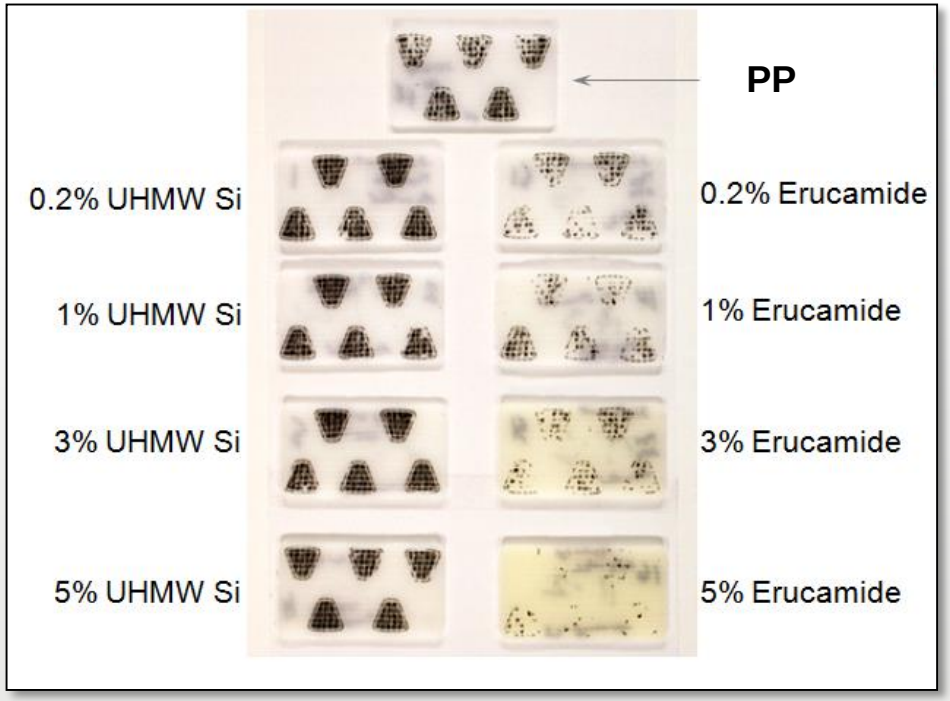
Myth 4: Silicones will mess up my product

Common complaints

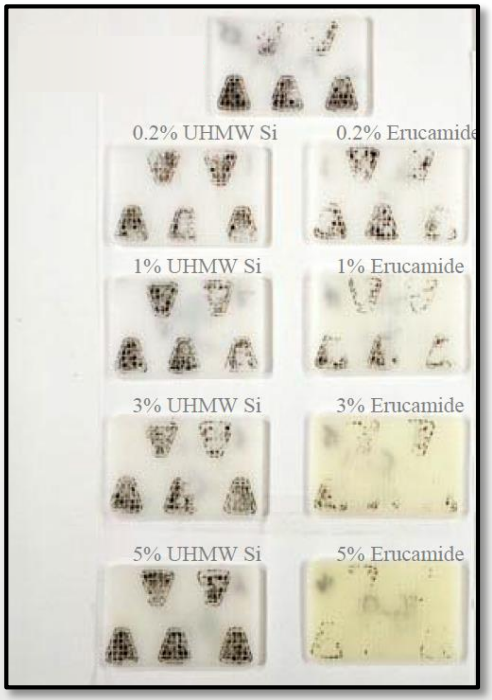
- Printability / paintability
- Adhesion
- Heat-sealability

Myth 4: Silicones will mess up my product

- Printability



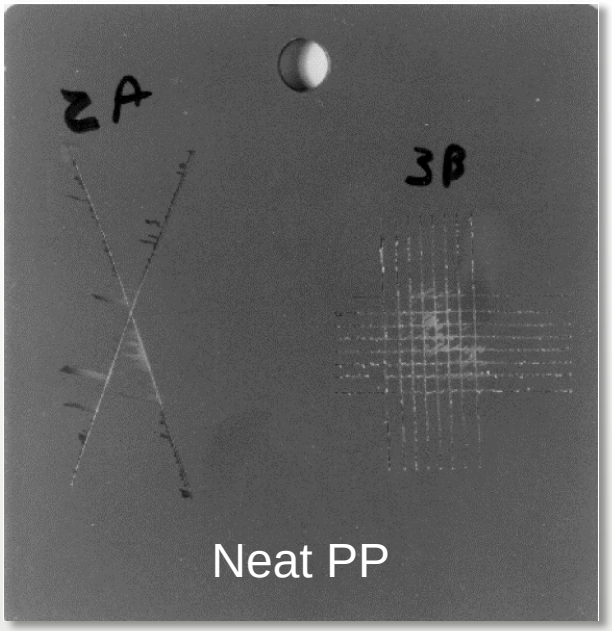
As molded

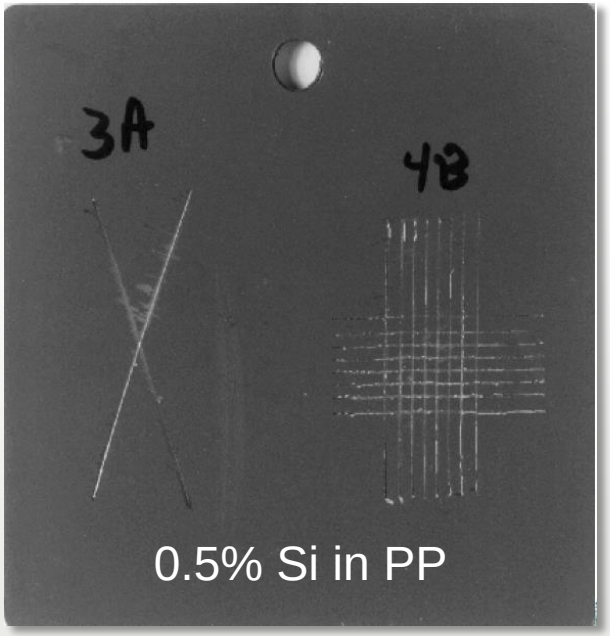


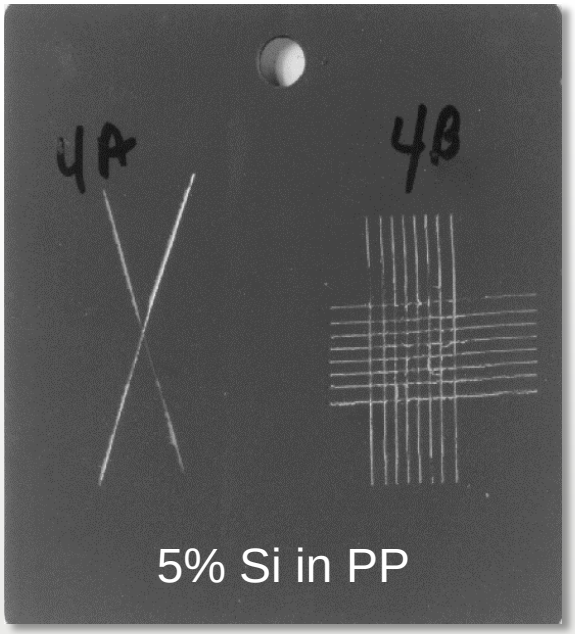
Heat Aged 3 Weeks at 50C

Myth 4: Silicones will mess up my product

- Adhesion







2A 3B 3A 4B 4A 4B

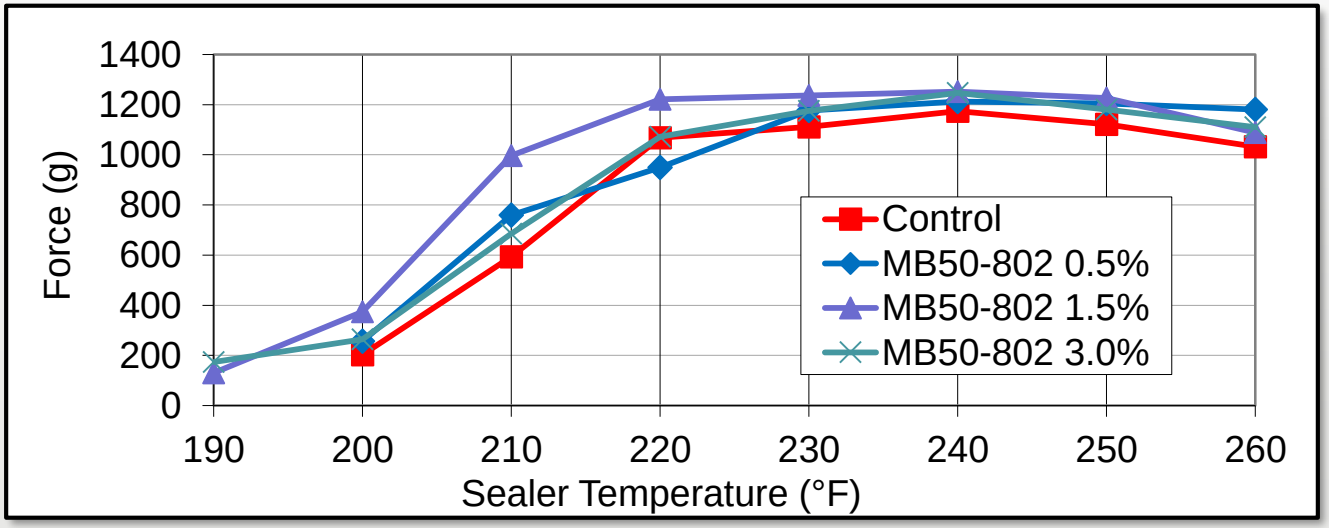
Increasing adhesion

Myth 4: Silicones will mess up my product

- Heat-sealability

Application:	Blown Film single layer
Material:	*Dow Corning*® MB50-802 Masterbatch at 2%
Process:	Coextrusion
Key Benefits:	Lower CoF of the film for processing benefits

Heat Seal Strength



Myth 5: Silicones cost too much for my application

- It is true that the silicone can be an additional ingredient in the recipe
  - Keep in mind that the multi-benefit silicone could replace other ingredients
- Silicones generally have a higher price than many organic alternatives

Myth 5: Silicones cost too much for my application

- Example of highly filled MDH / LLDPE / EVA compound running on a TSE

Myth 5: Silicones cost too much for my application

Example of highly filled MDH / LLDPE / EVA compound running on a TSE

- Standard formula

Myth 5: Silicones cost too much for my application

Example of highly filled MDH / LLDPE / EVA compound running on a TSE

- Standard formula

- Improved formula with silicone additive

Myth 5: Silicones cost too much for my application

- Including a silicone additive could add cost to the formulation
- The processing benefits brought by the silicone can reduce utilities and increase throughput
- Total costs are maintained or even reduced
- Extrusion or molded part quality, enhanced surface feel and slip would all be added value

When and How to Evaluate Silicone Additives

DOW CORNING

We help you invent the future.™

Dow Corning® Silicone-based Plastic Additives are engineered to deliver multiple benefits

Silicone-based plastic additives engineered by Dow Corning enable **novel and valuable material properties**, and improve processability of thermoplastic and thermoset compounds

This means **greater design freedom** for component and system designers . . .

and **higher production efficiencies** for material producers and component manufacturers

Dow Corning® Silicone-based Plastic Additives are engineered to be versatile

Property improvement for any thermoplastic or thermoset

- Chemical structures may be modified to yield a range of organo-functional species
- They may be very inert or highly reactive

Process improvement for any manufacturing process

For any compounding or component production process:

- Many forms . . . from low viscosity liquids to elastomers to solid resins
- Available neat or as masterbatch, dispersions, blends, solids, gels, emulsions

Dow Corning **engineers solutions**

Material Property Enhancement

For Polymer Compounds

- Lower coefficient of friction *(increased slip)*
- Surface look and feel modification
- Surface durability & quality *(Anti-Scratch without Tackiness)*
- VOC reduction *(replacement of more volatile components)*
- Fire retardant *(FR synergist)*
- Impact modifier
- Hydrophobicity
- Light diffusion

For Reinforcing Materials and Fillers

- Filler dispersion improvement *(dispersion within the compound)*
- Compatibility improvement *(between compound components)*
- Adhesion between ingredients *(between dissimilar materials)*
- Hydrophobic property increase

Processing Aid

- Extruder torque reduction
- Extruder throughput increase
- Lower energy consumption
- Die or plate build-up reduction
- Filler dispersion
- Extrudate quality
- Film slip improvement
- Mold release
- Improved flow into mold
- Reinforcement wetting
- Polymer crosslinking

WE CAN HELP YOU ADD IT UP

We simplify access to Si.

Dow Corning leverages its expertise in silicon and polymer chemistry, silicone manufacturing and plastics compounding to provide Si-based additives for plastics and composite materials in forms ranging from liquid to powder, and from rubber to pellets.

We help you achieve design freedom and productivity.

Our additives enhance and extend physical properties, improve processing of polymer compounds and reinforce filler to polymer bonds.

We help you innovate.

Collaborating with Dow Corning means you get access to the people, labs, pilot facilities and the global reach you need to help you successfully innovate. Together, we'll develop new solutions to help you differentiate in your market and maximize your chance of success.

We simplify access to the uniqueness and multiple benefits of silicone technology.

CONTACT US

To learn more about Dow Corning's wide range of solutions for plastics manufacturing, visit dowcorning.com/plascomp

If you have questions, email the Dow Corning Plastics team at plastics@dowcorning.com

For additional product samples, contact the Dow Corning Technical Information Center nearest you.

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