POSS® Flow Enhancers
Dispersants & Lubricants

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Overview

- What is POSS®?
- POSS® Flow enhancers
- Dispersants for pigments & fillers
- Lubricants
- POSS® production and safety
- Conclusions
POSS® Molecular Structure

Organic Groups
- Silane (-Si-H)
- Methyl
- Ethyl
- iButyl
- iOctyl
- Phenyl
- Acrylate
- Methacrylate
- Epoxy
- Vinyl
- Fluoroalkyl
- Alcohols
- Amines
- Thiols
- Carboxylic acid
- Sulphonic acid
- PEG/PEO
- etc…
POSS® is a unique hybrid organic-inorganic composition.
What does POSS® look like?

Solid

Semi-solid

Liquid
What can POSS® do for you?

- Increased $T_g$
- Lubrication
- Hydrophobicity
- Flame retardance
- Biocompatibility
- Oxidation resistance
- Reduce friction
- Permeability
- Solvent resistance
- Low volatility
- Catalytic activity
- Improved Flow
- Passivation
- As a dispersant
- New Patents
POSS® Flow Aids
Flow Enhancement in COC (5% POSS®)

- SO1450: 65%
- MS0825: 148%

260°C 2.16kg
Nanoreinforced® Cyclic Olefin Copolymer

- POSS® needed to mold thin-walled part
- Weight reduction (30%) compared to GF/FR PP
- Retained mechanical/thermal performance
- Improved anti-icing
- Reduced dust build-up
- Increased operating temperature range
POSS® Flow PEEK Masterbatch

**Increasing Melt Flow with POSS® Masterbatch**

- **10%**: 27%
- **20%**: 82%
- **50%**: 504%

**Decreasing Extruder Torque with POSS® Masterbatch**

- **10%**: 17%
- **20%**: 28%
- **50%**: 57%
POSS® Flow Aids for Complex Parts

SpecialChem / Omnexus Webinar March 31st
POSS® Dispersant Stability

Temperature (°C) vs. Weight (%)

- Stearic Acid
- POSS® Dispersant 1
- POSS® Dispersant 2

Graph shows the thermal stability of Stearic Acid and two POSS® Dispersants under nitrogen at 20°C/min.

20°C / min under Nitrogen
POSS® Dispersants Reduce Viscosity

Complex Viscosity (Pa.S) vs Frequency (Hz)

- Control
- 3% MS0825
- 3% SO1458
- 3% SO1455

30% Hexagonal Boron Nitride in Squalane Cone-Plate
POSS® Dispersant allows Higher Loadings

Viscosity of Titanium Dioxide Dispersed in Oil

- No Dispersant
- POSS® Dispersant

Viscosity @ 10sec⁻¹
TiO$_2$ with POSS® Dispersant in PEEK

TiO$_2$ in PEEK no Dispersant

TiO$_2$ in PEEK POSS® Dispersant
Why use POSS® Dispersants?

• Improve aesthetics, mechanical properties and processing
• Thermally stable
• Easy application
• Drop in, i.e. no pre-hydrolysis step
• No VOC
• Precise 1-2 nm coating
• Wide range of fillers:
  
titanium carbide, boron nitride, yttria, silica, titanium dioxide, calcium carbonate, mica, clay, wollastonite, iron oxides, titanium diboride, bismuth subcarbonate, metal particles etc…
POSS® Lubricants
POSS® Lubricants
Standard bearing oil          100% PEG POSS

Falex film strength tester 5kg load for 3 minutes
POSS® Lubricants

- High temperature stability 200-300°C
- Very low volatility
- Inert
- Safe
- Stable at high and low pH
- From non-polar to water-soluble
- Easily formulated
POSS® Production & Safety
Several of the larger production volume POSS® types are TSCA listed

Octaisobutyl POSS® MS0825
US Category IV Oral LD50 > 5000 mg/kg

Octamethyl POSS® MS0830
EU Testing Oral LD50 > 2000 mg/kg

Dodecaphenyl POSS® MS0802
EU Testing Oral LD50 > 2000 mg/kg

Does not require the risk phrase R22 "Harmful if Swallowed"
Fish testing showed no toxicity
FDA food contact approvals underway
POSS® Pricing

- Capacity in the hundreds of tons per annum
- Standard purity > 97%
- Special purity grades available (low metals, electronics grades)
Summary

• POSS® additives available neat or in masterbatch concentrate

• The hybrid structure provides unique property combinations

• Hybrid Plastics works closely with customers to develop new products

• New POSS® applications and products arriving all the time