PTFE Lubricant Powders – A Guide to Applications, Properties and Processing

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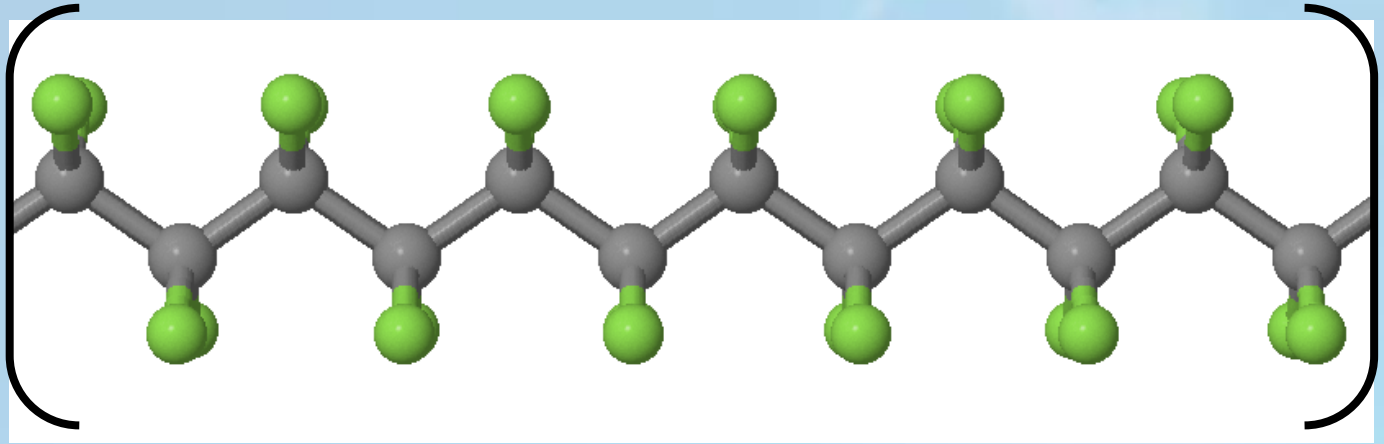
Helen Thompson

AGC Chemicals Europe, Ltd.

Today's Presentation

- What is PTFE
- PTFE lubricant Powders and how they are produced
- Applications for lubricant powders:
  - Oils and greases
  - Inks, Paints and Coatings
  - Additive to plastics and rubbers
  - Other applications
- Summary

What is PTFE?



- Polytetrafluoroethylene
  - Fluoropolymer of tetrafluoroethylene (TFE)
- High Molecular Weight
- Formed from Carbon and Fluorine
  - Very strong C – F bonds
- Hydrophobic

Key Properties of PTFE

- Heat resistance – usable in a wide temperature range
- Chemical resistance to most chemicals and solvents
- Nonflammability
- Low Dielectric Constant
- Low Friction
- Non stick
- Weather resistance

PTFE Production

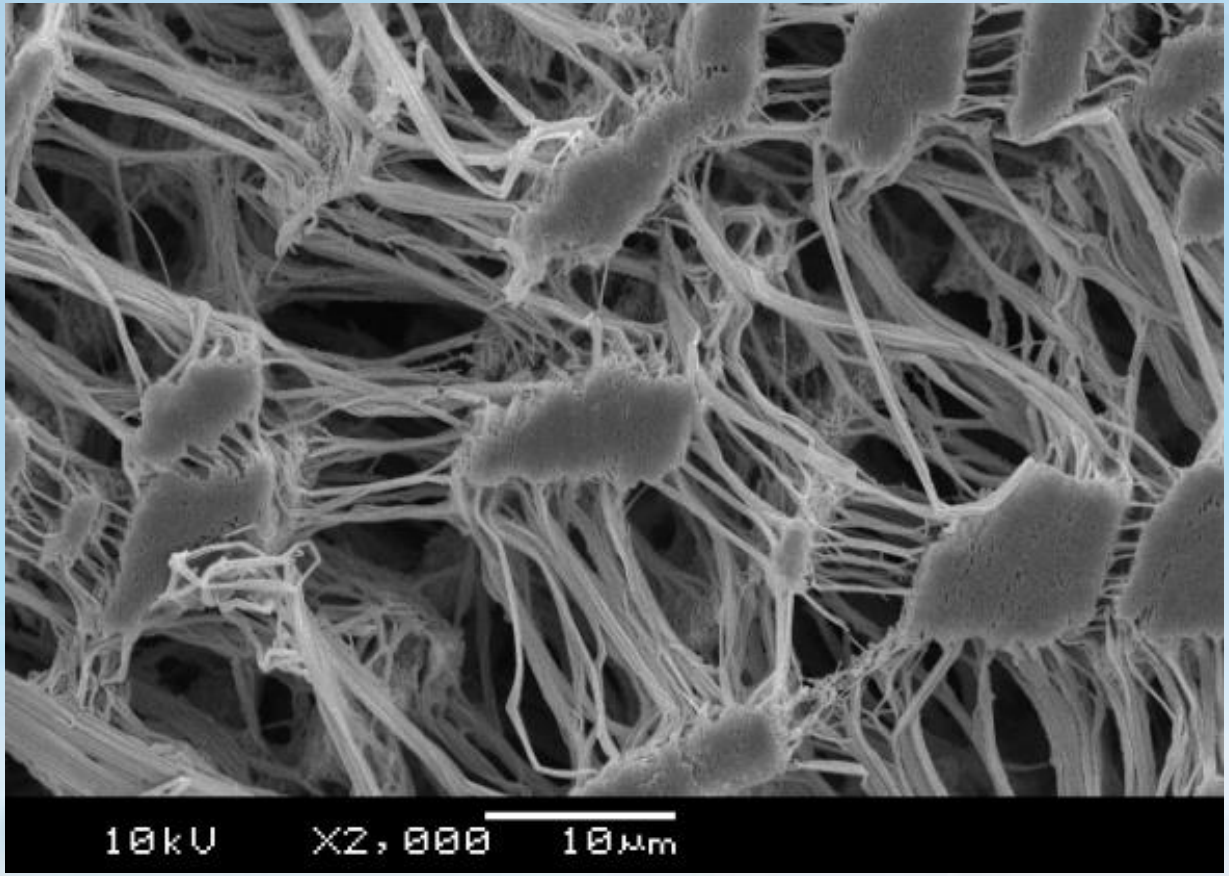
- PTFE produced by emulsion or suspension polymerisation of TFE

- Aqueous dispersion, fine powder or granular particles

- Can be modified by the use of a small amount of comonomer

- High molecular weight makes it difficult to reduce the particle size

Fibrillation of PTFE



SEM image of Fluon PTFE CD grades after fibrillation

PTFE Lubricant powder grades are:

- Lower Molecular Weight
- Dry lubricants
- Finely divided PTFE
- Used for reducing friction in blends
- Easily dispersible

Production of low Mw PTFE

- Directly Polymerised
- Reduce molecular weight of granular or dispersion PTFE:
- Using irradiation:
  - Gamma or electron beam
- Thermal decomposition

Lubricant powder grades are:

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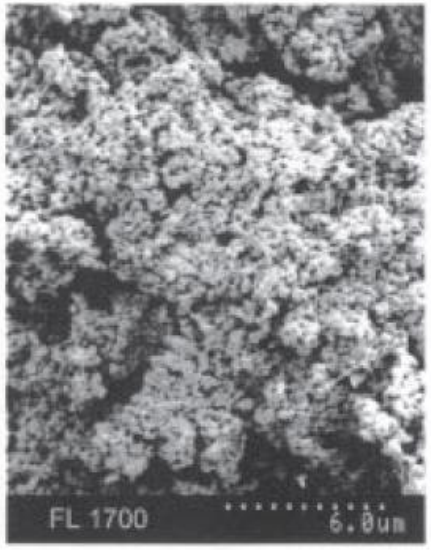
Particle differences:

Milled granular powder based

Granular powder based

Fine powder based



Milled fine powder based

Lubricant Powder applications

- Oils and greases
- Inks, Paints and Coatings
- Thermoplastics, Thermosets and Rubber
- Thread seal pastes
- Aerosols and Mould release agents
- Dry film lubrication

Oils and Greases

- Low Mw dispersion based PTFE preferred
- Levels up to 15% added
- Help to reduce friction and wear
- Can be used as a thickening additive in a grease if a large surface area grade is selected

Advantages of using PTFE in Oils / Greases

- Clean
- Low starting torque
- Good at low/high temperatures
- Chemically resistant
- Long lasting

Application areas:

Chemical plant valves, automotive, food and water, etc.

Inks

- Used as a replacement for hydrocarbon waxes
- Less PTFE is need but can be used together to reduce cost
- Levels up to 3% of non-volatile constituents added
- Stirred or milled into formulation
- Particle size similar to print thickness

Advantages of using PTFE in Inks

- Better abrasion ‘rub’ resistance
- Reduced blocking
- Reduced friction allowing sliding
- Excellent temperature resistance
- Chemically inert
- Easy dispersion

Application areas:

Offset, heat-set, gravure and flexographic inks

Paint & Coating applications

- Generally small particle size is needed
- Need to consider how to disperse and stability of dispersion
- Can use high Mw PTFE aqueous dispersion
- More common to use Low Mw PTFE powder
  - Might be mixed with a hydrocarbon wax for easier use
- Stirred or milled into formulation
- Addition level depends upon the application

Advantages of using PTFE in Paints and Coatings

- Increased abrasion resistance
- Easy to Clean
- Reduced friction in industrial paints
- Corrosion resistance
- Water repellancy

Application areas:

Metal decoration coatings, industrial coatings, domestic paint, marine and aerospace paints

Polymer applications

- No need for a masterbatch
- 10 to 20% addition level depending on matrix polymer
  - Generally higher in more crystalline polymers
- Use in thermoplastics and thermosets
- Granular based PTFE typically used
- Typically dry mixed before processing
- Processed as the unmodified polymer

Advantages of adding PTFE to Polymers

- Reduced friction and wear
- Increased PV rating in bearings
- Ease of processing of finished product (mould release)
- Cheaper than producing pure PTFE parts

Application areas:

Gears, bearings, components for instruments, automotive

Thermoplastic Wear Modification

Polymer	% of FL1690 (w/w)	Coefficient of Friction (against Steel)	Wear Factor, K $10E\text{-}10$ $\frac{in^3 \text{ min}}{ft/lb/hr}$
Polyacetal	0	0.21	65
	5	0.18	40
	10	0.17	30
	15	0.16	20
	20	0.12	13
Polystyrene	0	0.32	3000
	15	0.14	175
Polycarbonate	0	0.38	2500
	5	0.20	125
	10	0.17	85
	15	0.15	75
	20	0.14	70
Nylon 6	0	0.26	200
	15	0.20	30
	20	0.19	15
Nylon 6/6	0	0.28	200
	5	0.20	80
	20	0.18	12

Elastomer applications

- Typically dry mixed with fillers before compounding
- Typical addition levels 15 – 25%
- Higher levels give the best release properties
- Can be some reduction in mechanical properties and there smaller particle size preferred

Advantages of using PTFE in Elastomers

- Improved mould release
- Reduced friction
- Increased abrasion resistance
- Improved tear strength

Application areas:

Used in nitrile rubbers, polyurethane, butadiene-acrylonitrile, styrene-butadiene, etc.

Other Lubricant Powder applications

- Thread seal pastes
- Aerosols and Mould release agents
  - Built in release properties
  - No need to apply mould release agent
- Dry film lubrication
  - Used as is or by aerosol application
  - Very clean

AGC Fluon® PTFE lubricating powder Grade Range

Grade	Bulk Density (g/l)	Mean Particle Size - Laser Diffraction (µm)	Surface Area (m^2/g)	FDA Compositional Approval	Applications
FL1650	440	40	1.8	yes	High thermal stability grade recommended for use in thermoplastics
FL1679	1200	750*	-	yes	Used after milling as an additive in printing inks, oils, grease & industrial finishes
FL1680	400	14	1.6	yes	Low porosity lubricant used mainly in printing inks and industrial finishes
FL1690	440	40	1.8	yes	General purpose lubricant, for use in thermoplastics and elastomers
L169E	400	16	3	yes	Premium grade with narrow particle size distribution and high thermal stability for use in thermoplastics
FL1700	530	18	7.8	yes	Friable grade (to sub-micron particle size) used in rubber, elastomers, printing inks, oils, greases and industrial finishes. Suitable for metal decoration (can coating), gravure and flexographic printing inks
FL1700HT	620	25	5.8	yes	Oils and greases in drinking water applications
FL1710	450	6	4.6	yes	Fine particle size with good dispersion in low/high shear mixers used particularly in inks and industrial finishes
FL1730H	480	4	5.5	no	Fine particle size version of FL1710

* Measured by sieve analysis

Summary

- PTFE is a polymer with distinct properties
- Lower molecular weight PTFE can be used as an additive to many systems
- Some of the properties of PTFE given to the product
- Many products are suitable for food / water contact applications
- Easier to handle than high Mw PTFE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Thank you for your attention