



Siltech LLC
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Dacula, Ga. 30019

Surface Tension Reduction of Motor Oil Utilizing Specialty Silicone Technology

March 10, 2009

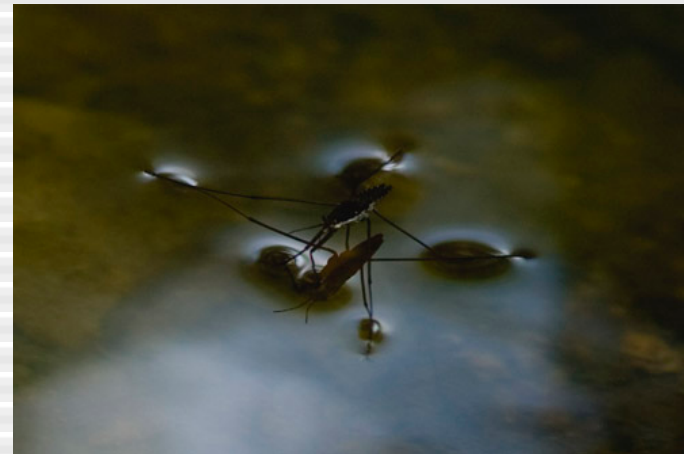
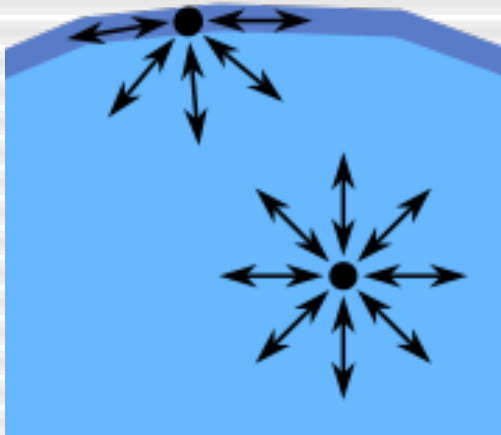
Tony O'Lenick
Siltech LLC

Surface Tension Reduction

Engine Oil Project

Surface Tension Definition

- A property of liquids arising from unbalanced molecular cohesive forces at or near the surface, as a result of which the surface tends to contract and has properties resembling those of a stretched elastic membrane.

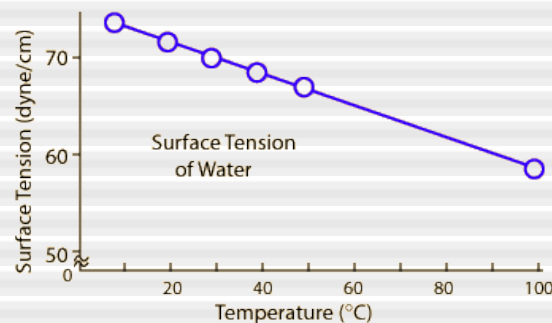


Water Strider

Surface Tension Reduction

Structural Requirements

- The reduction of surface tension in oils is dependent upon the ability of an amphiphilic silicone to reach the liquid surface and orient itself properly.
- Surface Tension decreases with increasing temperature.



Surface Tension Reduction

Performance Requirements

- An effective silicone product must possess balanced solubility.
 - Sufficiently soluble to provide clarity
 - Sufficiently insoluble to migrate to the surface
- The most efficient molecules for reducing the surface tension are those that provide the lowest surface tension at the lowest concentration.

Surface Tension Reduction

Conventional Silicone Technology

- Lower surface tension can also be achieved by utilizing conventional silicones (dimethyl silicones).
- However, conventional silicones are poorly soluble in conventional and synthetic oils....principally used as antifoamants

Surface Tension Reduction

Novel Silicone Technology

- Siltech LLC has developed and filed patents on a series of silicone compounds that have the ability to lower surface tension of both conventional and synthetic engine oils.
- The silicone compounds are active at treat rates of less than 1% active ingredient.
- Branded as Silube[®] 5016 and Silube[®] 6016.

Surface Tension Reduction

Novel Silicone Technology

Silube[®] 5016 and Silube[®] 6016.

INCI: Cetyl dimethicone crosspolymer

The reduction of the surface tension of motor oil will increase miles per gallon

and

Reduce the wear on the engine, resulting in increased engine life.

Surface Tension Reduction

Silube™ Structural and Mechanistic Features

- Selected alkyl groups on the silicone polymer improves the solubility of the Silube® Silicones in oils.
- Very limited crosslink density
 - Lowest free energy of the oil occurs when the silicone polymer is pushed to the oil/metal interface where it surprisingly lowers surface tension.

Excellent Solubility in Engine Oils



10W-30 Synthetic Control (A)

(A) + 1% Silube® 5016

Surface Tension Reduction

Conventional Silicones

	1% in Lube A 10W-30 Mineral Oil mN/m	1% in Lube B 10W-30 Synthetic mN/m
Surface Tension:		
Octyl dimethicone	29.3	29.3
Cetyl Dimethicone	29.9	29.7
Stearyl dimethicone	Solid	Solid
Lauryl Dimethicone	30.9	30.6
350 cSt Silicone Fluid	Insoluble	Insoluble
50 cSt silicone fluid	Insoluble	Insoluble
Control (Untreated lube)	31.0	30.8

Surface Tension Reduction

Silube[®] Silicones

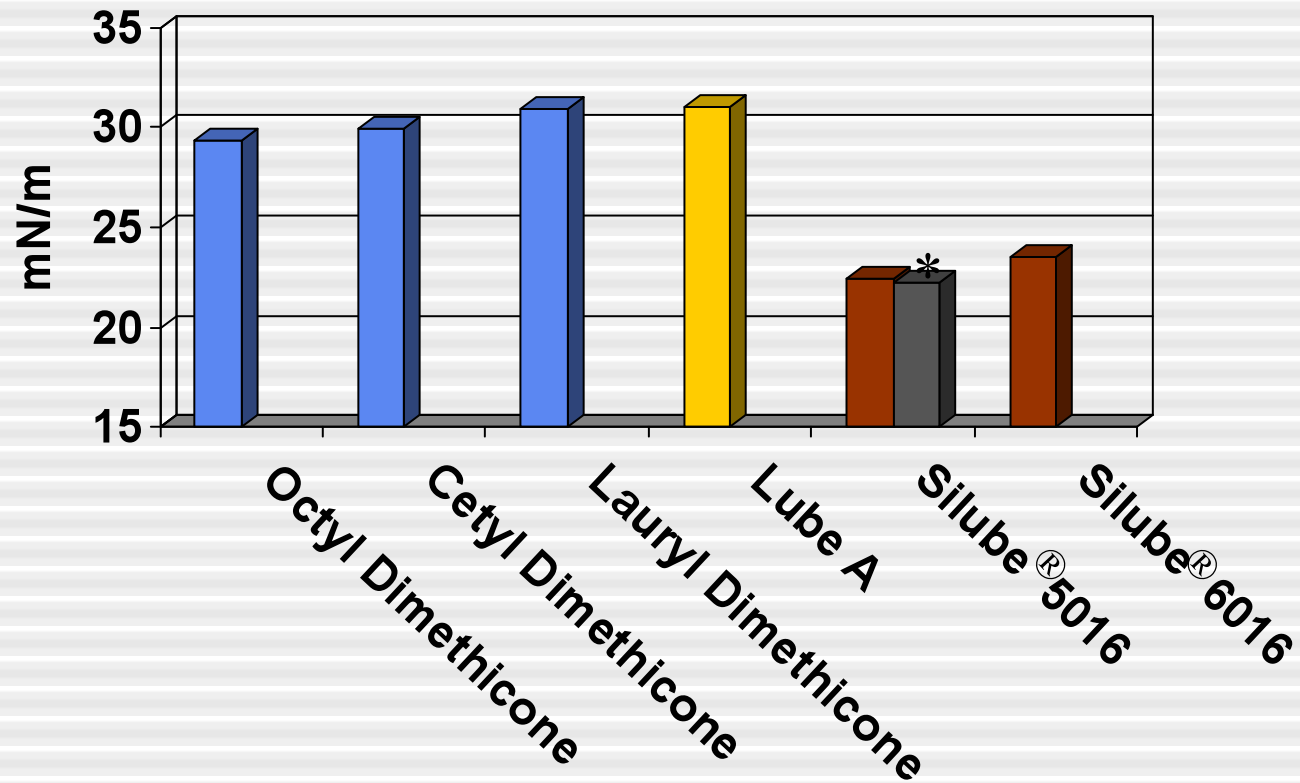
	1% in Lube A 10W-30 Mineral Oil mN/m	0.5% in Lube A 10W-30 Mineral Oil mN/m	1% in Lube B 10W-30 Synthetic mN/m	0.5% in Lube B 10W-30 Synthetic mN/m
Surface Tension:				
Silube [®] 5016	22.5	22.2	22.0	22.2
Silube [®] 6016	23.5	NA	23.1	NA
Control (Untreated lube)	31.0	31.0	30.8	30.8

Surface Tension reductions of 24 – 29 % obtained with Silube[®] Silicones at 0.5 and 1 % treat rates

ASTM D 7490

Surface Tension Reduction

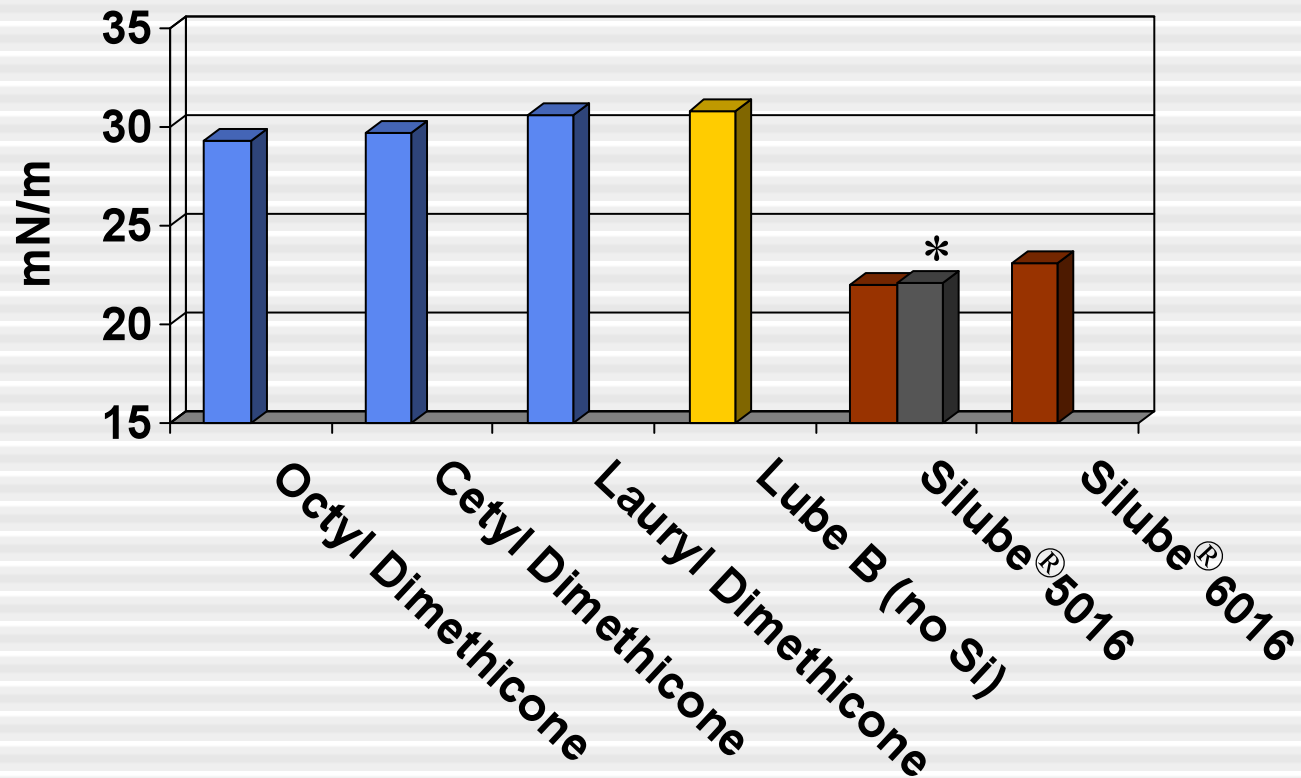
Conventional Engine Oil



Additive Treat Rate = 1.0 % in Lube A (* = 0.5 %)

Surface Tension Reduction

Synthetic Engine Oil



Additive Treat Rate = 1.0 % in Lube B (* = 0.5 %)

Implications to Lubrication

- Does reduced surface tension have the same effect as reduced viscosity?
 - Will a 10W-30 perform like a 5W-20 or an ISO VG 100 like an ISO VG 32 ?
- Does improved wettability/penetrability result in improved lube/lube additive performance?
- USP 5,320,761 (Pennzoil) cites Surface Tension reduction as way to improve fuel economy.
 - Employ detergents at ~ 3.0 % to maintain 20 mN/m during use.



Thank You

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Surface Tension Reduction

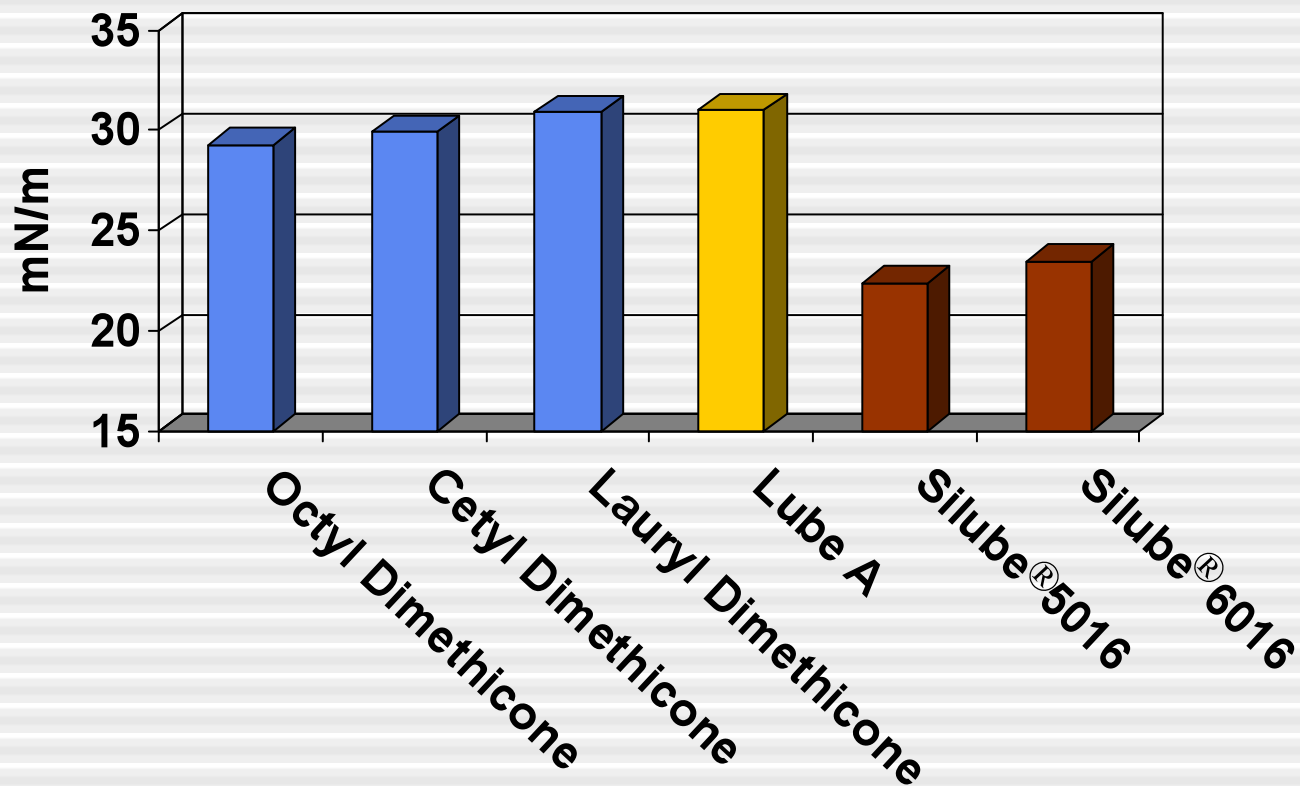
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Surface Tension Reduction

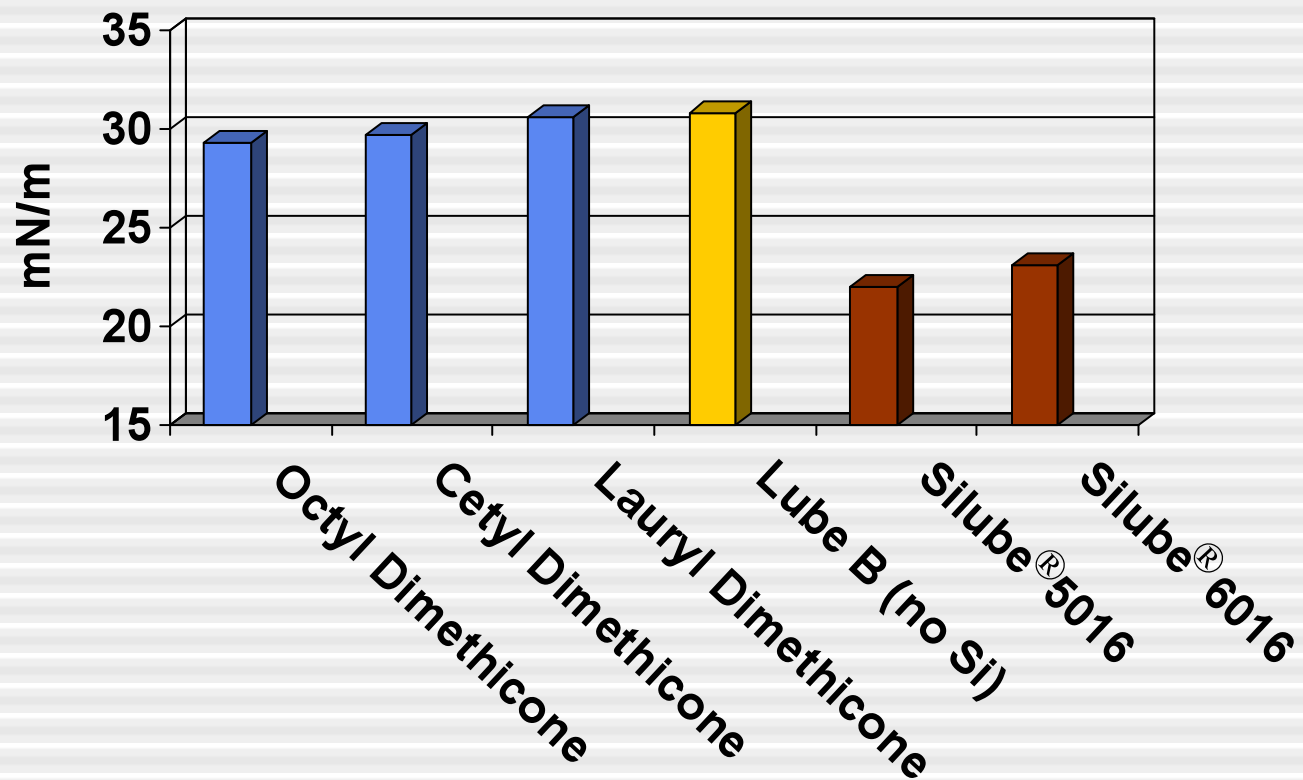
Conventional Engine Oil



Additive Treat Rate = 1.0 % in Lube A

Surface Tension Reduction

Synthetic Engine Oil



Additive Treat Rate = 1.0 % in Lube B