CERAMIC REINFORCED TECHNOLOGIES

CERFLON® and CERTEX™ FluoroCeramic Chemistry

CERFLON® Market Scale Analysis Booklet

A Guide and Manual

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Section IV: Market Scale Analysis Booklet

Sheet 1A	"CONFIDENTIAL"	CERFLON® USA	Automotive Market Analysis 2012		"CONFIDENTIAL"	
Application	**Benefit**	**Principal Users**	**Market Size (USA Only)**	**Cerflon in lbs. SLA 2010**	**pTFE in lbs. 18% @ 80%**	**hBN in lbs. 18% @ 20%**
			Assumes a 2.5% Market Penetration			
PCMO	Reduction of ZDDP, easier compliance with CAFÉ regs.	Shell PQS, Valvoline, Castrol	Basis is 750 million gallons PCMO	**3.2mm lbs.**	**461K lbs.**	**115K lbs.**
	Backward compatibility, possible "Memory Effect" for	Mobil, Chevron Texaco,	Est. market penetration 2.5% = 18.75 million gal			
	fuel economy per DuPont/Conoco work. Better solution for	Lubrizol, Infineum, Afton, Oronite	75 million quarts.Treat @ 0.75 oz. per qt.			
	for incresed lubricity and durability/longevity than MoS2		56,250,000 oz. = 439K gallons = 3.2mm lbs			
	"Blue" marketing benefit					
	"Grand Slam"		**Total USA New Auto Market Adoption**			
	Majority replacement of ZDDP	Same	Assuming only new US car adpotion, even though	**7.3mm lbs.**	**1.05mm lbs.**	**263K lbs.**
			product would be backward compatible, equals			
			156mm qts /year at @ 2008 sales of 13mm and 100%			
			penetration. Also assumes 2 oil changes/year (low)			
			and .75 oz. treat rate at only 4qt capacity (low)			
			Over 5 years this impacts 20% of vehicles.			
Gear Lubricants	Part of "Blue" marketing concept.	Same	250mm gal. Market penetration @ **.5%**	**234K lbs.**	**34K lbs.**	**5K lbs.**
			Treat @ 0.75 oz per qt with "Blue" Cerflon.			
Greases	PTFE and MoS_2 is already widely used and accepted in	All oil companies, Chemtool,	400mm lbs. including "Food Grade"	**1.4mm lbs.**	**1.12mm lbs**	**280K lbs.**
	automotive, general purpose and food grade greases.	Lubrizol, Ethyl, Infineum, Oronite	Market penetration @ **.5%** = 1.4mm lbs	**Cerflon Dry Blend**		
	Versus MoS_2, Cerflon® is white!! Big advantage!					
				12.1mm lbs.	**2.66mm lbs**	**663K lbs.**
Other Industrial	**Applications (Source: Acheson Colloids)**					
Engine Oils	Off-highway, Mining, Construction		23mm lbs. @ 5% Market Penetration	**1.2mm lbs.**	**327K lbs**	**83K lbs.**
Cutting & Grinding	Fabricating, Manufacturing		9.7mm lbs. @ 5% Market Penetration	**470K lbs.**	**67K lbs.**	**17K lbs**
Gear Oils	Manufacturing		6.4mm lbs. @ 5% Market Penetration	**320K lbs.**	**45K lbs.**	**12K lbs.**
Greases	Manufacturing		8mm lbs. @ 5% Market Penetration	**400K lbs.**	**57K lbs**	**14K lbs**
Compressor Fl.	Manufacturing		2mm lbs. @ 5% Market Penetration	**100K lbs.**	**14K lbs.**	**4K lbs.**
Anti-Seize & Assy	Manufacturing		1.4mm lbs. @ 5% Market Penetration	**70K lbs.**	**10K lbs.**	**3K lbs.**
Drawing Lubes	Manufacturing		1.5mm lbs. @ 5% Market Penetration	**75K lbs.**	**10K lbs.**	**3K lbs.**
				2.6mm lbs.	**530K lbs.**	**136K lbs.**
		WILD CARDS WITH "SYSTEM BLUE"				
Anti-Wear and	**Contingent upon Mike Westrick's used oil testing**	All Major Oil	At its peak was >$100mm market	**?**		
Friction Modifier	Cerflon brings stronger claim set and new marketing	Slick 50, Valvoline E.T.				
Restorer	opportunities					
Oil Additives	Elevates conventional motor oil to next generation	STP, Bardahl, CD2, Rislone etc.	$68mm at retail only. Could be big DIFM	**250K lbs.**	**35.5K lbs.**	**9K lbs.**
	"Blue" with Cerflon. Strong maketing benefit		product. Use "Blue" to re-energize tired			
			category. Market share could be 25-50%.			
			At 10% of 40mm unit mkt = 4mm units at 1.0 oz.			
Penetrants	Superior performance in lubricity and durability as	Liquid Wrench, WD40, Tri Flow,	180 million units. Market penetration @10%	**337.5K lbs.**	**48K lbs.**	**12K lbs.**
	demonstrated by Liquid Wrench L4	PB Blaster. All industrial	18 million units @ 0.3 oz. per Unit			
		aerosolizers, military				
Anti Freeze	Anti-corrosive durable coating with no heat transfer loss	Prestone, Zerex, Peak	180 million gallons. Market penetration @ 5%	**281K lbs.**	**40K lbs.**	**10K lbs.**
	Water pump lube		9 million units @ 0.5 oz. per unit			
Waxes	PTFE is already widely used and accepted in automotive	Clorox, Blue Coral, Meguiars	25 million units @ 5% market penetration	**20K lbs.**	**3K lbs.**	**720 lbs.**
	waxes. Cerflon is more durable and BN has UV protection	Mothers, The Wax Shop	1.25 million units @ 0.25 oz. per unit			
	See possible use of SPF scale as marketing tool	Turtle Wax				
	Looking at household waxes. Large market	**S.C. Johnson etc.**				
Car Wash	Durable residual coating with UV protection (?). "Blue"	Blue Coral, Clorox, Meguiars	20 million units. Market penetration @ 5%	**16K lbs.**	**2.3K lbs.**	**575 lbs.**
		Turtle Wax, Mothers etc.	1 million units @ 0.25 oz. per unit			

Sheet 2	"CONFIDENTIAL" FluoroCeramic	CERFLON® Dispersions and Powders	Market Analysis 2012		"CONFIDENTIAL"	
Application	**Benefit**	**Principal Users**	**Market Size (Total)**	**Cerflon in lbs.**	**PTFE in lbs. @ 14.2% or 80% Dry Bl.**	**hBN in lbs. @ 3.6% or 20% Dry Bl.**
Polymer Blends / Composites-Thermoplastics	New grades of higher value, high temperature polymers such as PPS, PEEK, PEI, PC, POM, PA, PPS, ABS, PS, HIPS, PP, thermoset plastics & elastomers	Compound houses such as RTP and polymer manufacturers like GE LNP, St-Gobain PPL, other plastics mfg.	**50mm lbs.**	**3mm lbs. Cerflon Dry Blend**	**2.4mm lbs.**	**600K lbs.**
Color additives for all polymers	More efficient and easier processing of color	Manufacturers of color additives for hi-temp polymers at 1% share	**30mm lbs.**	**300K lbs. Cerflon Dry Blend**	**240K lbs.**	**60K lbs.**
Aqueous dispersions (AD) for glass cloth coatings	More durable dispersion coating with Cerflon vs. pTFE	Chemfab, other dispersion manufacturers at 10% share	**4mm lbs.**	**400K lbs. Cerflon Dry Blend**	**320K lbs.**	**80K lbs.**
Coatings - Dry Film	Durability with no loss of COF, longevity	Industrial including medical device mfgs, food process industry, consumer, hardware at 4% share	**5mm lbs.**	**200K lbs. Cerflon Dispersion**	**28K lbs. @ 14.2%**	**7K lbs. @ 3.6%**
Fine Powder: Make expanded membrane like Gore-Tex (Certex)	Possibly more durable , resistant membrane..stronger, easier to use	Industrial manufacturers of filters, gaskets, seals and textiles at 10% share	**8mm lbs.**	**800K lbs. Cerflon Dry Blend**	**640K lbs.**	**160K lbs.**
Cosmetics	Lower cost BN w/o property compromise	SGC, Momentive and ESK hBN customers at 20% share	**500K lbs.**	**100K lbs. Cerflon Dry Blend**	**80K lbs.**	**20K lbs.**
Improved cardboard lubricant	Improved dry film lubricant for packaging materials	Cardboard manufacturers at 10% share	**1mm lbs.**	**100K lbs. Cerflon Dry Blend**	**80K lbs.**	**20K lbs.**
			98.5mm lbs.	**4.9mm lbs.**	**3.8mm lbs.**	**947K lbs.**
Other Opportunities						
Process Aids	More efficient and easier processing without melt fracture or sharkskin	Buckmaster license needed for PE & PP market. Compete with Dyneon.	**100mm lbs.**	**1-2mm lbs Cerflon Dry Blend**	**800K-1.6mm lbs**	**200-400K lbs**
Food grade lubes and coatings	Durability, longevity over pTFE now in use	Chevron, Fiske Brothers, all coaters	**Substantial**	**Cerflon Dry Blend or Cerflon Dispersion**		
Paint	Durability, easier to clean, longevity anti-corrosion , water proofing, flexibility heat conductivity and toner resistance	Sherwin Williams, PPG, DuPont Finishes		**Cerflon Dry Blend**		
Researching Cerflon with engineered polymers like nylon		Major users of engineered parts like heavy and light duty automotive equipment mfgs		**Cerflon Dry Blend**		
Printer's ink	Anti-sticking, less abrasion, improved definition and luster of prints, durability against fading, good water-proof			**Cerflon Dry Blend or Cerflon Dispersion**		
Sportswear & fabric coatings	Certex™ Stronger than Gore-Tex® ?			**Cerflon Dry Blend**		

Cerflon® in Plastics:

FluoroCeramic Cerflon® powders in plastics processing and finished products:

Following are phenomena that occur when Boron Nitride (BN) powders are added to PTFE powders which results in FluoroCeramic Cerflon®. The end results would differ based on the ratio of BN to PTFE and the grades of each material that can be easily and quickly engineered for specific applications.

It can be concluded that Cerflon® powders or BN added to PTFE enhance plastics processing and finished products with the following benefits:

1. Enhances thermal conductivity and electrical insulation. BN has a high thermal conductivity, especially relative to common fillers, such as talc. BN's soft hexagonal crystalline particles allow excellent particle-to-particle contact that provides a superior thermal path. BN's electrical insulation properties offer superior dielectric strength to plastics.

2. Improves the nucleation efficiency during processing with the ability to control crystal structure and size. There are BN grades that nucleate certain plastics, such as Teflon, better than talc and other common nucleation agents.

3. Provides slip and wear resistance during processing and for finished products. Hexagonal BN's graphite-like crystal structure provides excellent lubrication. BN will adhere to surfaces and produce a solid lubricating film, resulting in lower part wear when subjected to sliding or rotating motion. BN is non-abrasive and will provide lubrication through processing. It is also white!

4. Enhances mold release. High temperature resistance and chemical inertness allow BN to perform extremely well as a release agent.

5. Promotes high-temperature stability. BN is stable and non-reactive with a low coefficient of thermal expansion. These properties make BN a useful reinforcement for materials that are processed at higher temperatures or that are designed for high-temperature service.

Some "Out of the Box" FluoroCeramic Cerflon® thoughts….

It is known that the paste extrusion of PTFE produces the highest quality wire coating from fluoropolymers. Difficulties in processing the polymer, which results in high cost, are the main issues that limit the use of paste-extruded products. As a batch process, paste extrusion must run at very low rates. The use of Boron Nitride (BN) in the paste extrusion process can mitigate or eliminate these problems.

Because paste extrusion of PTFE is done in a ram extruder, the factor that limits the speed of the extrusion is the buildup of pressure in the extruder or the load on the ram. CRT did work with DuPont Dow Elastomers (DDE) that demonstrated for a T-62 control sample, *without* BN, the load on the ram increased from about 3000 lb. to 3700 lb. in only 200 sec. and was continuing to rise when the experiment was stopped. For the samples *with* BN, the load quickly rose to 2900 lb and then remained constant. This is a 20% decrease in load for the BN sample after only 200 sec. and could translate into a significant increase in speed for the paste extrusion process while also producing less stress and wear on the equipment.

The reason that paste extrusion has been a batch process with a ram extruder rather than a continuous process with a screw extruder is that the pressure in the screw extruder builds up too quickly. The fact that the pressure remained constant during the paste extrusion of the BN sample could signify that with the added BN, the paste resin *could* be extruded using a continuous screw extruder. This would allow long continuous lengths of extruded wire rather that the short lengths that are commonly produced. *In a similar manner, continuous PTFE film and tubing could be produced!*

To reduce the processing problems associated with paste extrusion, PTFE producers use modified PTFE resins that have inferior physical properties. It appears that BN will allow the extrusion of an unmodified T-62 type resin that would also have the best physical properties of most resins.

This process is not covered under the DuPont Buckmaster (U.S. 5,688,457) patent. That patent claims an extrusion process that is run at a shear rate that is at least 20% greater than the shear rate for the onset of melt fracture. PTFE resin does not undergo melt fracture in the paste extrusion process, but instead the load on the ram builds up to a level that is too high and therefore limits extrusion speed.

It is not unreasonable to believe that in the near future all paste extrusion of PTFE will be done with the addition of Boron Nitride.

Some more “Out of the Box” FluoroCeramic Cerflon® thoughts....

1. Engineer a better processing fluoroelastomer with property improvements such as strength and permeation resistance, etc.
2. Explore the process aid business of fluoroelastomers.
3. Our past work showed that the addition of CERFLON® additives into fluoroelastomers allows easier processing. It may also allow the development of a higher molecular weight fluoroelastomer that can be easily processed and there may also be property improvements.
4. The use of CERFLON® can allow smoother tubing as well as easier processing for small tubing (“spaghetti tubing”).
5. We should look for process and product improvement in the film business.
6. Engineer a breakthrough for a new, higher speed, effective FEP resin with the use of a CERFLON® additive or straight Boron Nitride. You could also use this with color concentrates for FEP.