



New Nano Additives Patented and Recently Produced for Engineering Plastics Upgrade



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Weakness on Engineering Plastics

- A major obstacle for engineering plastics is **weakness** on mechanical strength, toughness, wear and tear resistance, etc.

How to resolve weakness issues?

- Our Nano technology can offer an overall solution as a process drop-in technology to upgrade mechanical strength for engineering plastics

Nano Technology Overall Solution

- Our Nano technology can produce commercially two **Nano additives: SiC whiskers and Al_2O_3 whiskers** aimed to form stronger bonding with raw pellets of engineering plastics and other additives
- Reinforcing composites resulted in new and improved engineering plastics made by PE, PP, PVC

Nano-Additives Project Team



- **Dr. Howard Paul, P. E., West Virginia University in Chemical Engineering, America P & G Co. Process lead for new Nano-additives technology applications.**



- **Dr. Mike Chen, Oregon State University, Ph.D. in Mechanical Engineering. Lead contract and mechanical installation for Nano-additives commercial production.**



- **Dr. Bob Kline, University of North Carolina, Ph.D. in Materials Science. Lead Nano R & D Patent to build Nano additives commercial production lines**

Two New Nano-Additives



- Two new Nano-additives produced:
 1. Nano-silicon carbide (SiC) whiskers
 2. Nano-alumina (Al_2O_3) whiskers
- Can be utilized as Process Drop-in Technology a small ratio and different combinations mixed with raw pellets and other additives

Nano silicon carbide (SiC) whisker

Physical and Chemical Properties:

- **Physical state:** Solid (powder).
- **Odor:** Odorless
- **Molecular Weight:** 40.1 g/mole
- **Color:** Bluish-black (Gray)
- **Melting Point:** 2700°C (4892°F)
- **Specific Gravity:** 3.2 (Water = 1)

Nano alumina (Al_2O_3) whisker

Physical and Chemical Properties:

- **Physical state:** Solid (powder)
- **Odor:** Odorless
- **Molecular Weight:** 101.96 g/mole
- **Color:** White
- **Melting Point:** 2072°C (3761.6°F)
- **Specific Gravity:** 4 (Water = 1)

US Patented Nano-Additives

U.S. Patent No. 8,359,9
Issued January 29, 2013

*The
United
States
of
America*

Vivek R. Dave
Mark J. Cola
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Inventors

COMPOSITE PROJECTILE



U.S. Patent No. 8,426,3
Issued April 23, 2013

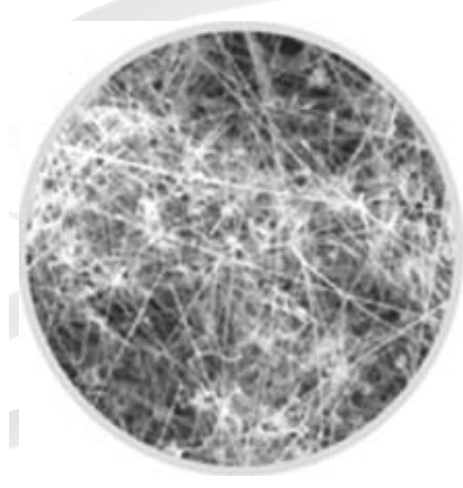
*The
United
States
of
America*

C. Robert Kline, Jr.
Inventor

SURFACE-ETCHED ETCHED
ALUMINA/SiC MINI-WHISKER
COMPOSITE MATERIAL
AND USES THEREOF



- D: 400nm L: 25um**
L / D ratio: about 60
- **SiC whiskers**
 - **Al₂O₃ whiskers**



Nano whiskers under an electron microscope

US Patented Nano-Additives



Kline Technical Consulting LLC
Warrior-minded, engineered security solutions

www.klinenm.com



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**Produced commercially two new
Nano-additives with our USA
Patent #: US8426328**

(Currently No USA Competitors)

Nano-additives R & D Laboratory



Nano-Additives Indoor Production

Website: <http://www.klinenm.com.cn/>

Nano Additives Indoor production lines



Upgrade Engineering Plastics

Nano-Additives can provide an overall solution to upgrade engineering plastics made by PE/PP/PVC for major technical indicators:

- **Excellent mechanical strength**
- **Higher wear & tear abrasion resistance**
- **Better corrosion & chemical resistance**
- **Higher temperatures resistance**
- **Lower temperatures resistance**

Upgrade Engineering Plastics

Adding 4% Nano-SiC additives to reduce 32% - 42% wear & tear abrasion resistance.



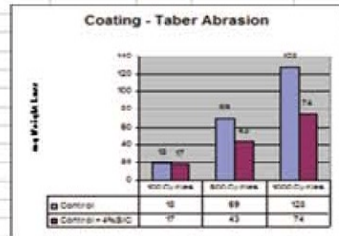
COATINGS - TABER ABRASION TEST RESULTS

EPOXY

HI BUILD 90
4% SiC By Weight
CS 17 Wheel, 1000 grams

Cycles	100	500	1000
Control	18 mg	69 mg	128 mg
SiC @ 4%	17 mg	43 mg	74 mg

% Weight Loss Improvement 5.6% 37.7% 42.2%

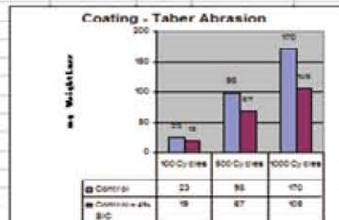


VINYL ESTER (Gel Coat)

4% SiC By Weight
CS 17 Wheel, 1000 grams
a. CHEM PROOF 410

Cycles	100	500	1000
Control	23 mg	98 mg	170 mg
SiC @ 4%	19 mg	67 mg	105 mg

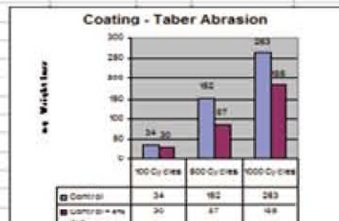
% Weight Loss Improvement 17.4% 31.6% 38.2%



b. CP 141

Cycles	100	500	1000
Control	34 mg	152 mg	263 mg
SiC+ @ 4%	30 mg	87 mg	185 mg

% Weight Loss Improvement 11.8% 42.8% 29.7%



Upgrade Engineering Coating

Adding Nano additives for epoxy resin with vinyl ester to raise coating strength 10 times for aircraft carrier or yacht.



Upgrade Engineering Plastics

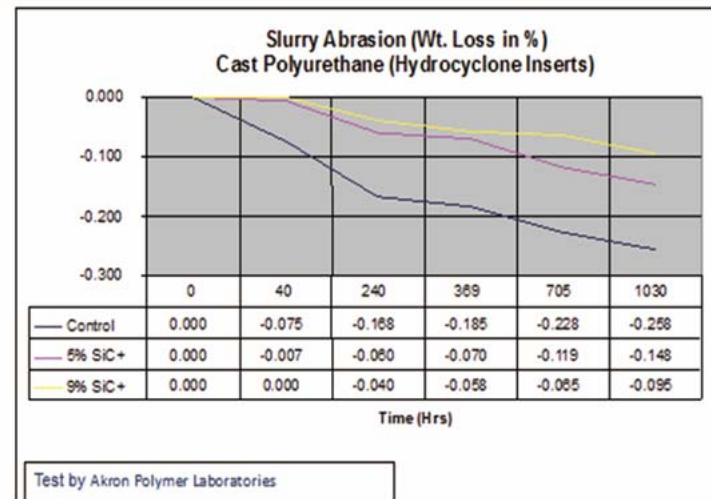
Adding 9% Nano-SiC additives for Polyurethane to raise wear and tear abrasion resistance by 3 times



CSG
Ceramic Sciences Group LLC

Testing with Cast Polyurethane

Source: Akron Polymer Laboratories

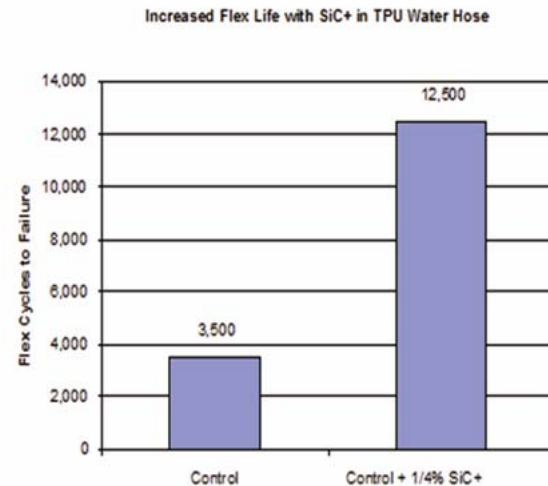


Upgrade Engineering Plastics

Adding 2.5% Nano-SiC for specialty plastics to **extend life span 4 times**

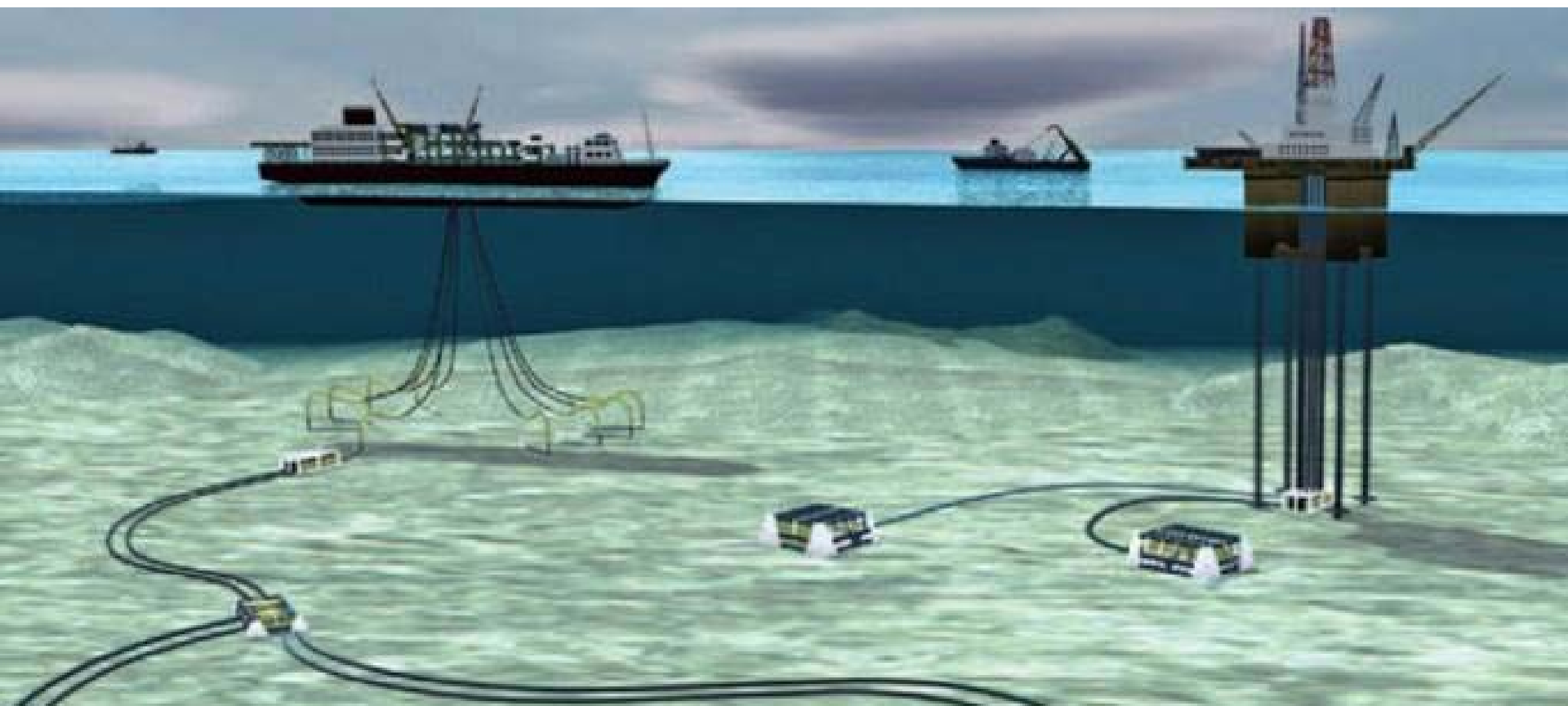


Testing with TPU Water Hose
Source: Polypur from A Schulman



Upgrade Engineering Plastics

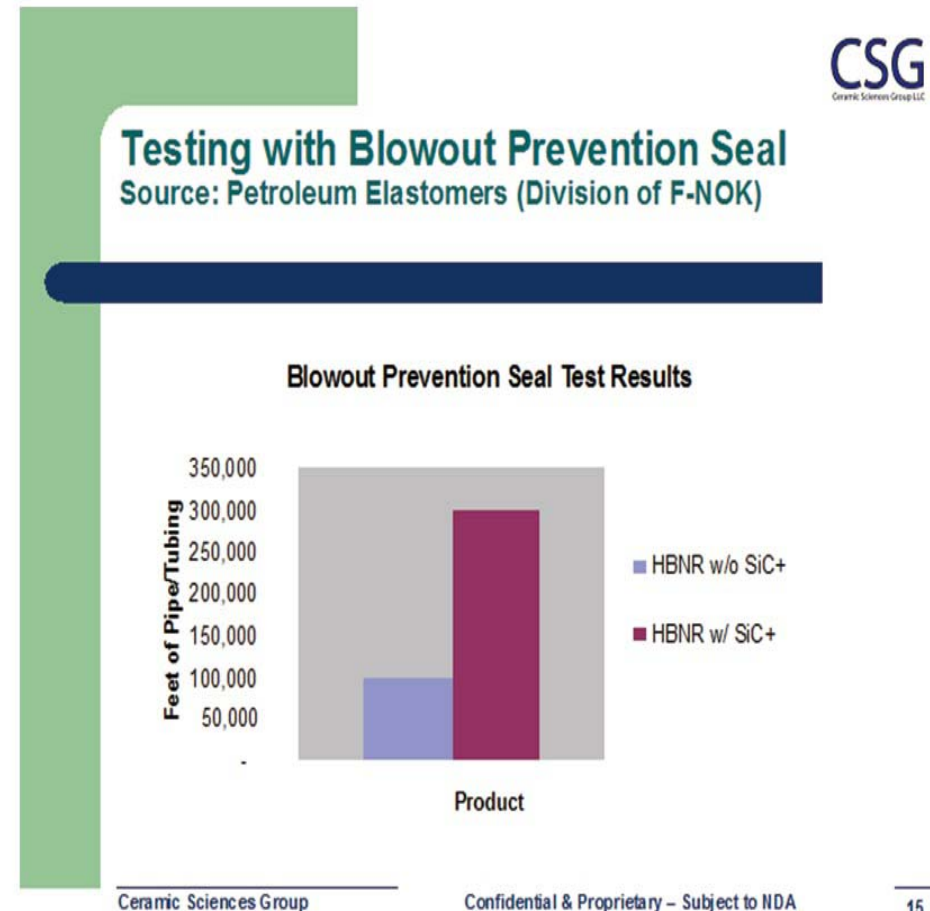
Adding 9% Nano-SiC additives for under-sea BOP seals to raise oil well pressure against explosion strength by 3 times.



Upgrade Engineering Plastics

Adding 9% Nano-SiC additives for BOP seals to raise mechanical strength 3 times

- BOP seals testing passed by respectful German & Japanese Inspection Institute
- “Without” Nano-seal only bear 100,000 feet piping
- With Nano-seal can bear 300,000 feet



Upgrade Engineering Plastics

Adding Nano additives to HDPE engineering plastics (**UHMWPE**) for **super mechanical strength**

PS-930 Ranger Body Armor (RBA)



Front view



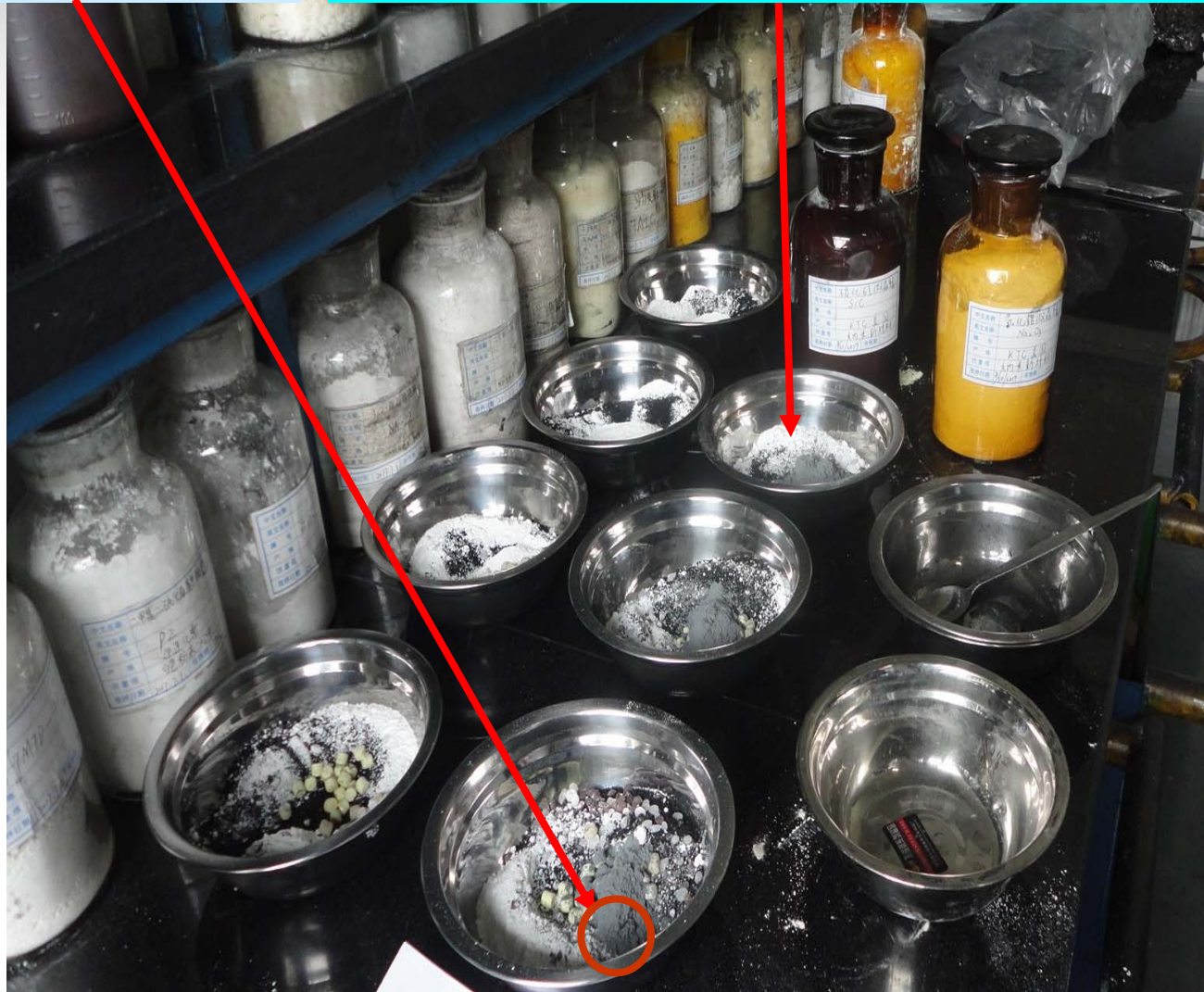
Rear view

Nano Technology R & D Consultation

KTC Nano-SiC Whiskers

Nano-alumina Whiskers

Our project team can offer free 2 kg Nano additives for R & D consultation at your field laboratory.



Nano Technology R & D Consultation

R & D Tested samples can be analyzed to confirm upgrade results between “without” and “With” adding Nano-additives for **Flexural Modulus, Notched IZOD Impact Strength and Tensile Strength, etc.**



SUMMARY

- **Two New Nano additives can upgrade mechanical strength for engineering plastics made by PE, PP, PVC for heavy duty engineering plastics, automotive parts, engineering accessory parts and blast-proof areas**
- **Our Nano project team can offer R & D consultation, and technology transfer to build two Nano additives commercial production lines**

SUMMARY

**New Nano-Additives
Technology for
A Win-Win Joint Venture**

Any question? Dr. Howard Paul:
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THANK YOU!