



Techno-Venture “AMTEC Co.,Ltd.” keeps providing benefit of customers

AMTEC Co.,Ltd.

PANASONIC Co.,Ltd GROUP

**Single crystal of Zinc oxide “Pana-Tetra”
gives you a new Techno story.**

Date of Establishment : March 01, 2006

Business started : April. 01, 2006

Capital : ¥80,000,000 (JPY) (96.25% invested by Panasonic corp.)

Business Line

Development, manufacturing, and sales of zinc oxide of single crystal (“Pana-Tetra”), composite material, diversified products (compound resin, antimicrobial agent, cleaning agent for molding machines, and functional sheet, etc.), and aquarium products (anti-algae material, water conditioner material, and filtration material, etc.)

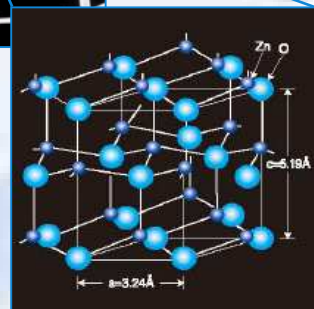
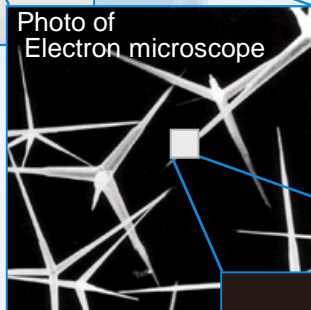
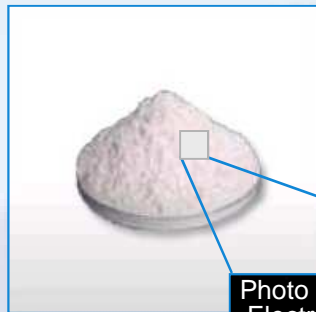
Location : Head Office 3-1-1 Inazu-cho, Toyonaka-city,
Osaka 561-0854, JAPAN
Phone: +81 6-6866-8508

Factory Takou 1-1 Kumasaka-machi, Kaga-city,
Ishikawa 922-0842 JAPAN
Phone: +81 761-72-5554



Basic Structure

- Tetrapod shaped single crystal of zinc oxide



Main Complex effect

- Improvement in the dimensional stability by the anisotropic relaxation effect
- Improvement of sliding, abrasion-resistant, and resistance to pressure
- Prevention from electrification
- Anti-algae and water conditioner material for aquarium

Chemical formula	ZnO
Shape	Tetrapod shape
Ave. length of leg	Abt. 10 μ m
Specific gravity	5.78
Relative density	Abt. 0.1
Sublimation point	1.720 $^{\circ}$ C
Volume resistance	Abt. 10 Ω ·cm



“Pana-Tetra” Compound examples

パナテトラ®
Epoch-making form
functional special filler
Pana-Tetra

Feature of “Pana-Tetra”

■ “Pana-Tetra” offers not only the special advantages of single crystal but also provides remarkable effects of compound resin, that no other compound-filler can achieve.

■ Various complex effect are the features

- ① Braking ability (Tire · Shoes)
- ② Thermal conductivity (Sheet · Resin)
- ③ Electric wave absorbency (Rubber · Paint)
- ④ Precise molding stability (Molding parts)
- ⑤ Resisting pressure ability (Seal ring)
- ⑥ Anti-abrasion capacity (Bearing · Gear)
- ⑦ Electrification prevention (Film · Paint)
- ⑧ Micro reinforcement (Adhesive)
- ⑨ Filterability (Filter)
- ⑩ Ultraviolet absorbency (cosmetic)
- ⑪ Super water repellence (Paint)
- ⑫ Anti-algae and Antibacterial properties (Paint · Resin · Water)

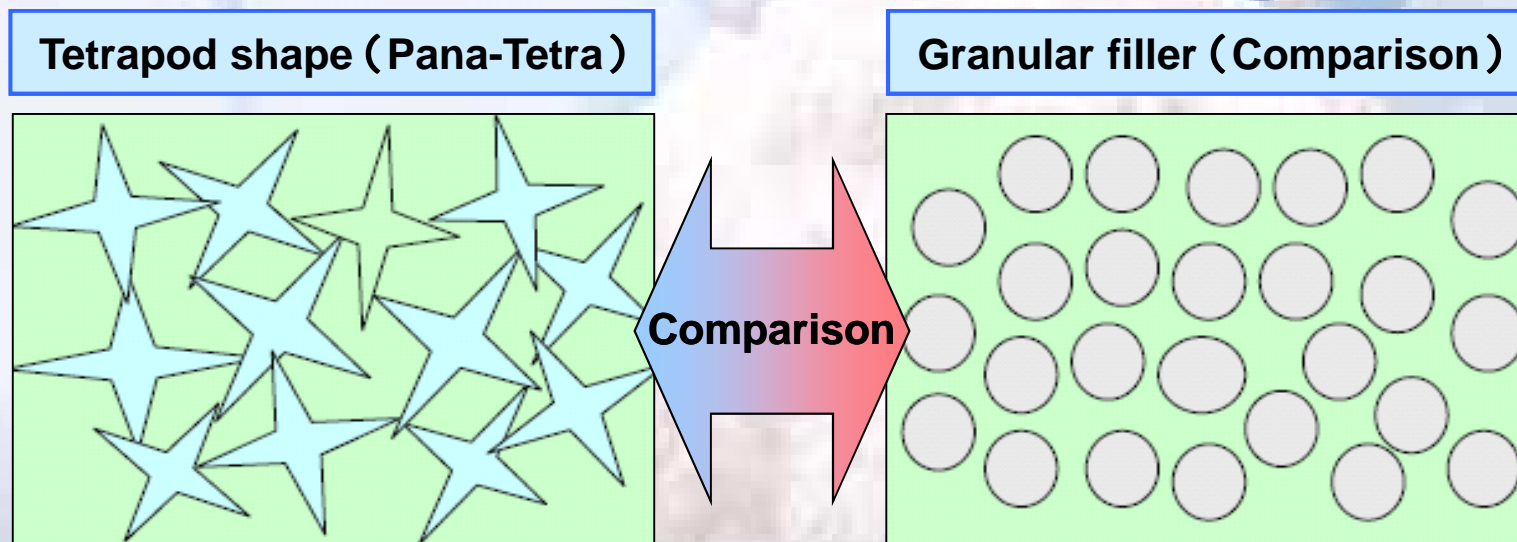


■ Pana-Tetra has a semiconductor characteristic, and it is the most suitable filler as electrification prevention paint. The electrification prevention characteristic is stable by electronic conductivity. In addition, we realize pure white and an arbitrary color coat.

Electrification prevention and conductivity

■ Pana-Tetra is three-dimensional tetrapod shape, so that it become advantageous to the conductive pass formation in comparison with granular filler

Conductive pass mechanism of Pana-Tetra

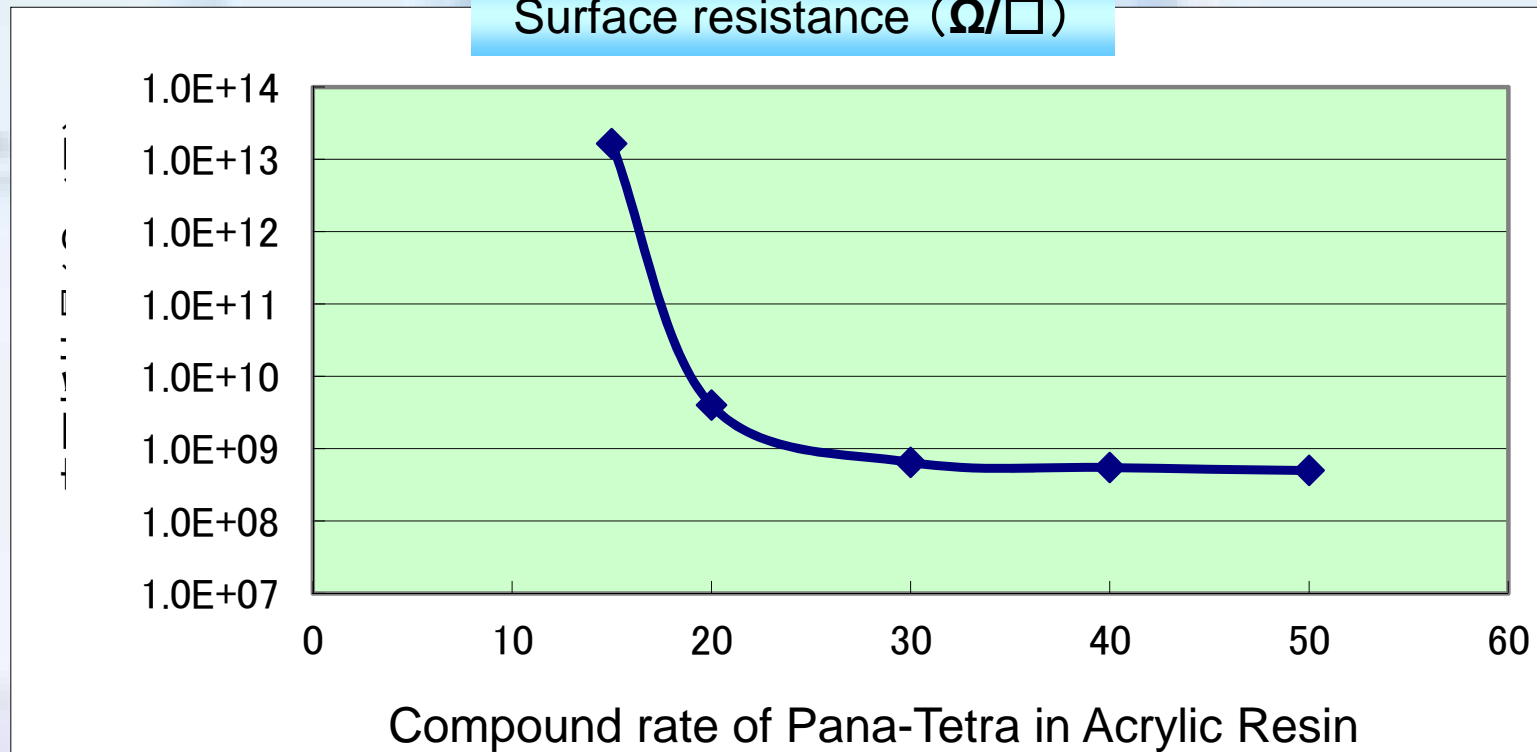




Surface resistance of paint with "Pana-tetra"

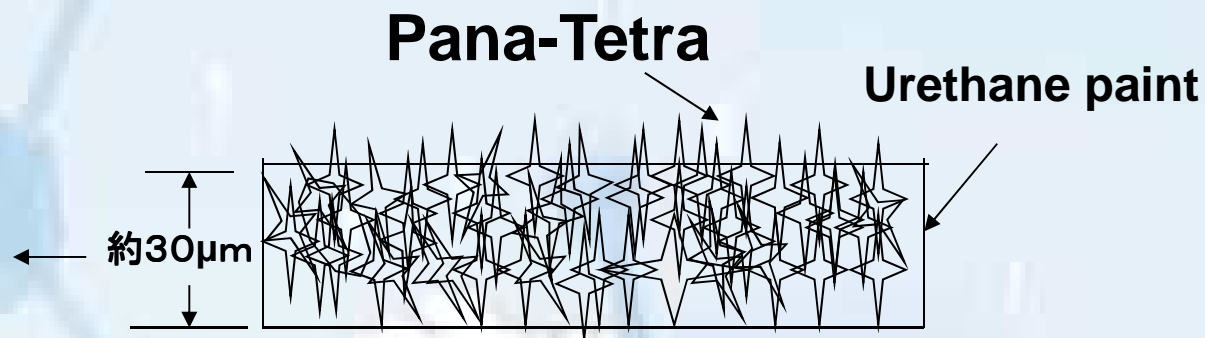
- Resin of Paint : Acrylic Resin (liquid type)
- Measuring instrument : Hiresta up MCP-HT450
- Measuring voltage : 500V

Surface resistance (Ω/\square)



Electrification prevention Urethane paint with Pana-Tetra

Electrification prevention Urethane
paint photograph (white)



Surface resistance $2 \sim 3 \times 10^7 \Omega$

Electrostatic decrement time
0.03second [5000V \Rightarrow 50V]
(MIL B 81750C)
21°C 13%RH



Miniscope1500 2013/03/04 14:07 x1.0k 100 um
Magnification=1000

Photo of Electron microscope



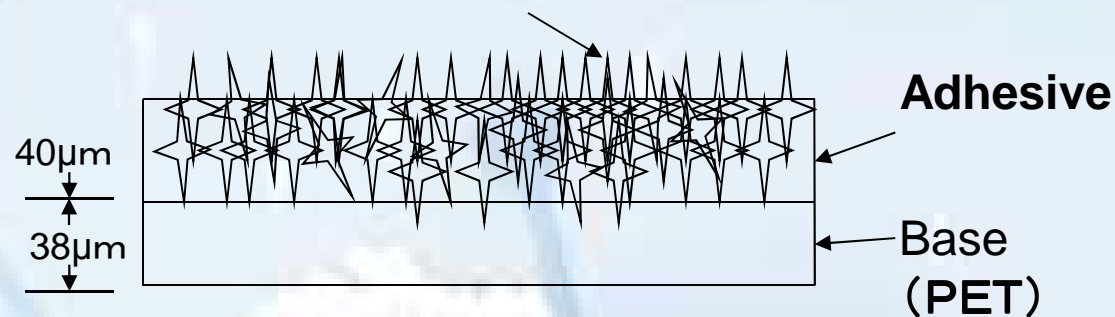
Electrification prevention paint ④

パナテトラ®
Epoch-making form
functional special filler
Pana-Tetra

Electrification prevention Film

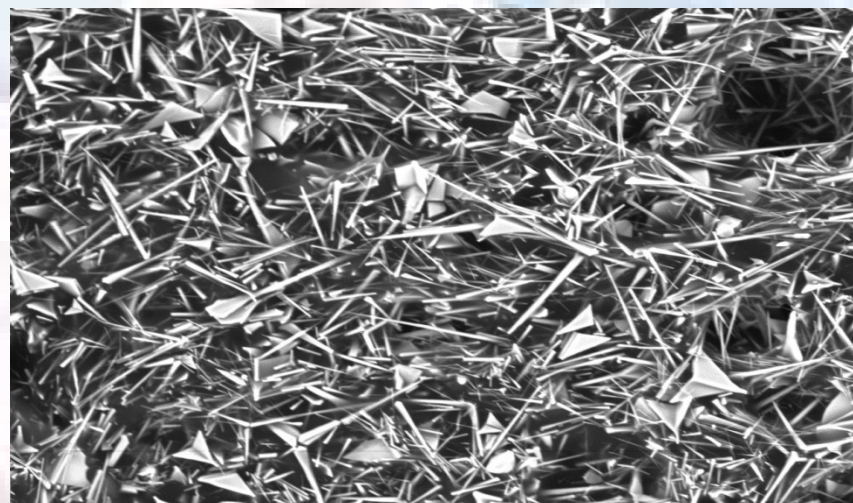


Pana-Tetra



Surface resistance $1.37 \times 10^9 \Omega$

Electrostatic decrement time
0.07second [5000V⇒50V]
(MIL B 81750C)
21°C 13%RH



Miniscope6301 2011/07/14 17:15 x2.0k 30 um
Magnification=2000

Photo of Electron microscope

① Simple compound with Pana-Tetra (PTFE)

	Pana-Tetra	Surface resistance (Ω)	Elec. start Pressure (V)	Elec. Pressure after 60sec (V)
Plate	0 wt%	1.0+E16	4,000	3,500
	20 wt%	1.0+E12	1,700	400
	40 wt%	1.0+E9	500	50

② Compound with Pana-Tetra and carbon fiber

	Carbon	Pana-Tetra	Surface resistance (Ω)	Elec. start Pressure (V)	Elec. Pressure after 60sec (V)
Plate	10 wt%	0 wt%	1.0+E7	480	270
		20 wt%	1.0+E5	170	80
Sheet	10 wt%	0 wt%	1.0+E7	2,500	2,300
		20 wt%	1.0+E5	800	150

Surface resistance : Transcendence marginal resistance meter (500V)

■ Because Pana-Tetra has a semiconductor characteristic and the dielectric characteristic, It shows a superior electric wave absorption characteristic. So that Pana-tetra run a fever efficiently by absorbing the microwaves such as microwave ovens (2.45GHz). In addition, the silicone rubber with Pana-Tetra is used as electric wave absorption parts.

Setting Pana-Tetra
in a microwave oven



A fever phenomenon
by the electric wave absorption



In tens of seconds
Pana-tetra turns to
incandescence

An electric wave absorption

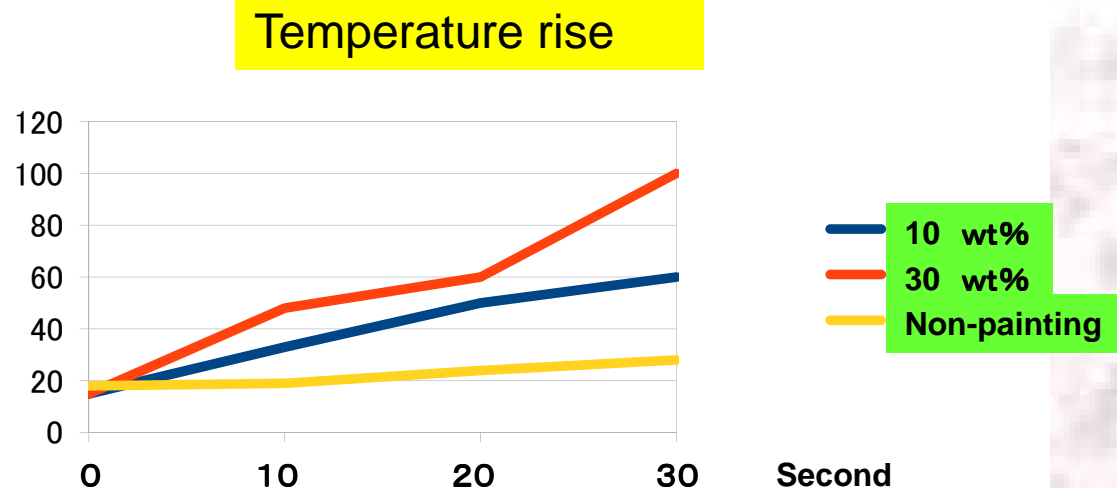
Temperature rise of paint with Pana-Tetra by the electric wave absorbency

An experiment method:

Applying Pana-Tetra composition urethane paint to ABS resin tablewar.
And confirming a temperature rise by the microwave oven heating.

A result: Temperature rise of paint with Pana-Tetra (10wt% and 30wt% composition)
(Microwave power :700W Oven time:30 seconds)

A painting part: 60-65 degrees Celsius Non-painting part: 25-30 degrees



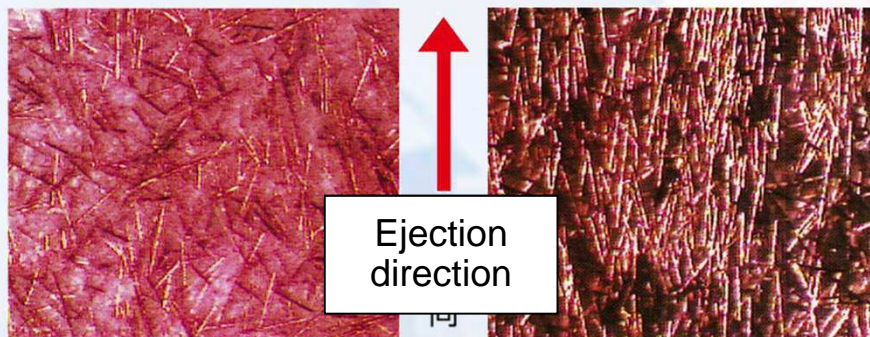
Paint with Pana-Tetra

By Pana-Tetra compound painting, the temperature rise of the container become early. As a result, shortening of the cooking time and partial heating cooking are possible. So that, it is possible to improve taste and by warming the whole tablewar

■ Pana-Tetra is the minute zinc oxide single crystal filler which can compound for improvement of the dimensions precision of the resin molding (the anisotropic relief of the molding shrinkage rate and the linear thermal expansion) and the surface smoothness and abrasion-resistant.

Size precision Improvement by anisotropic relief

By compounding Pana-tetra, the orientation of the glass fiber at the time of the injection molding (PBT resin with glass fiber) is reduced. So that anisotropy and warp of the molding resin are improved. In addition, Pana-Tetra improves surface smoothness by holding an exposure of glass fiber from the surface of resin.



Glass fiber : 30wt%
Pana-Tetra : 10wt%

Glass fiber : 30wt%
(Glittering fiber : Glass fiber)

Compared with mold shrinkage and warp of plate

Pana-Tetra (wt%)	Glass fiber (wt%)	Compared with mold shrinkage (TD/MD)	Warp of plate (%)
0	30	5.5	35
10	30	4.2	23
20	30	3.8	18
30	30	2.5	15

Measuring plate: 50 × 80mm t=1,5mm film gate

Warp of plate = $Smm / 100mm \times 100$



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■ Pana-Tetra improves surface smoothness by holding an exposure of glass fiber from the surface of resin (PC resin, PPS resin, & LCP resin) with glass fiber.

① PC resin / Pana-Tetra / Glass fiber compound

Pana-Tetra	Glass fiber	Average surface roughness (Ra)
0 wt %	30 wt %	6.5 μm
10 wt %	30 wt %	3.2 μm
20 wt %	30 wt %	2.0 μm

Measuring method : JIS B0601-01
 Measuring sample : Plate of PC resin
 (100 x 100 x 3mm)
 Measuring speed : 0.6mm/min
 Measuring direction
 : Perpendicular to the gate
 Measuring length : 100mm

#Measuring condition

Comparison photograph of surface of the PC resin

GF
30wt%



GF : 30wt%
Pana-Tetra
20wt%

GF
30wt%



GF : 30wt%
Pana-Tetra
10wt%

② PPS resin / Pana-Tetra / Glass fiber compound

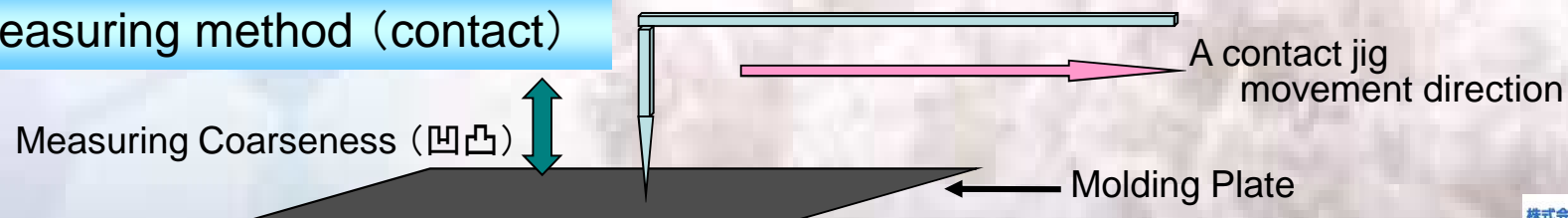
Pana-Tetra	Glass fiber	Average surface Roughness (Ra)	Height at the max Direction (Ry)
0 wt%	30 wt%	1.27 μm	14.3 μm
10 wt%	30 wt%	1.14 μm	13.1 μm
20 wt%	30 wt%	0.97 μm	11.5 μm
30 wt%	30 wt%	0.94 μm	10.8 μm

Measuring condition is the same of PC resin (#)

③ LCP resin / Pana-Tetra / Glass fiber compound

Pana-Tetra	Glass fiber	Average surface Roughness (Ra)
0 wt%	30 wt%	1.45 μm
15 wt%	30 wt%	0.62 μm

Measuring method (contact)



■ By compounding Pana-Tetra with sliding property Resin (POM etc.) used for bearing and special gear can improve an abrasion coefficient-resistant while maintaining a coefficient of friction of the based resin with the following characteristics of Pana-Tetra. In addition, by combining Pana-Tetra with the resin which is compound with carbon fiber or glass fiber, abrasion resistance can be improved.

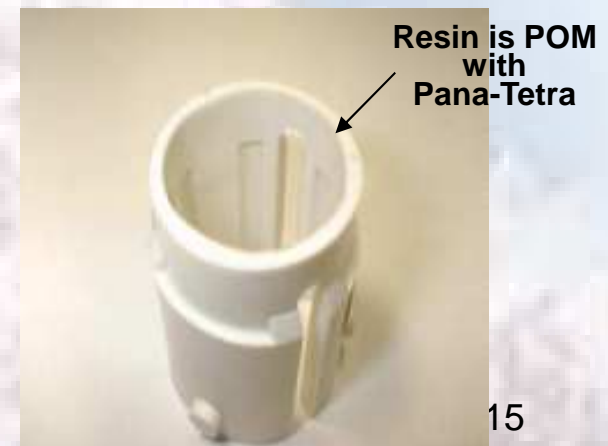
- 1) The hardness of Pana-Tetra is lower than glass fiber (Mohs hardness of Pana-Tetra is the half of the glass fiber), and an attack to the partner materials becomes soft.
- 2) Pana-Tetra is a thin filler, so that surface of resin roughness is reduced.
- 3) Because Pana-Tetra is good heat conduction ability, Pana-Tetra holds the outbreak of the frictional heat in check.

① Based resin : POM resin

Test Time (H)	Pana-Tetra 10 wt%		Without Pana-Tetra	
	Resin (mg)	Partner material (mg)	Resin (mg)	Partner material (mg)
1	0	0.3	1.5	1.2
10	0.9	0.8	7.1	1.4
30	1.4	0.8	29	1.7

Speed 1.1cm/sec, Partner material Fe S25C roughness 1.6a

Automotive part bearing



② Base : PPS resin (with Carbon fiber 10 wt%)

Pana-Tetra 40 wt%	Without Pana-Tetra
Resin (mm ³ / kmkg)	Resin (mm ³ / kmkg)
0.2	1.19
Speed 0.3m/sec, Surface pressure : 10kg / cm ² Test time : 1h, Partner material : S45C	

Audio tape head holder



③ Base : LCP resin (with Glass fiber 30 wt%)

Pana-Tetra 20 wt%	Without Pana-Tetra
Resin (mg)	Resin (mg)
0.5	136
Speed 300m/sec, Surface pressure : 20kg / cm ² Test time : 1h, Partner material : S55C	

Optical pick-up base



④ Base : PTFE resin (with Carbon fiber 10 wt%)

Pana-Tetra 20 wt%	Without Pana-Tetra
Resin (mg)	Resin (mg)
6.19	53.6
Speed 0.5m/sec, Surface pressure : 7.65kg / cm ² Test time : 8h, Partner material : AL(A5052 #800)	



■ When compounding resin of the disc brake pad with Pana-Tetra, abrasion-resistant of the disc brake pad can be improved.

Obtain excellent Abrasion-resistance of the disc brake pad

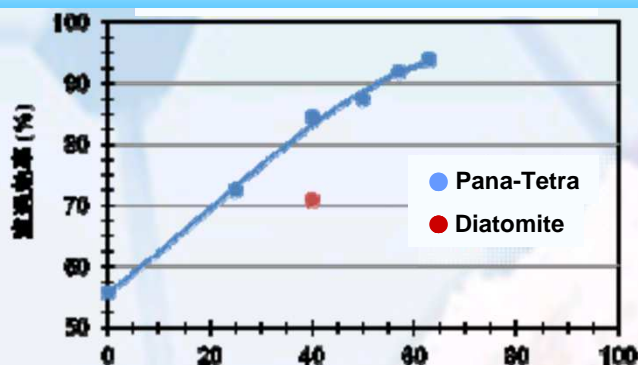
Braking condition	Start : 90 km/h End : 0 km/h
Braking cycle	500 cycle
Rotor temperature at the time of the braking start	150 °C
Effect of abrasion-resistance	With Pana-Tera 0.92 mm Comparison : Potassium titanate whisker composition 1.19 mm

Filtering characteristics ①

■ The filtration efficiency of the filter paper with Pana-Tetra is superior to diatomite filter paper.

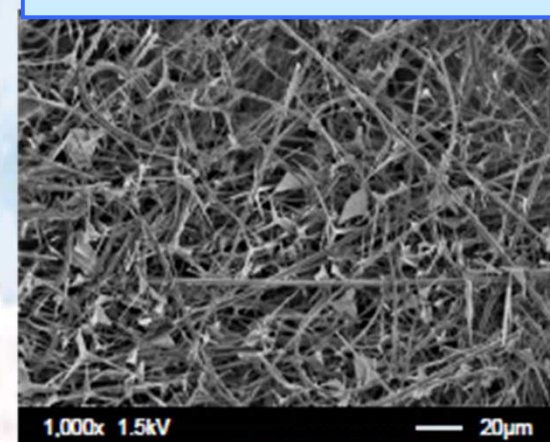
- 1) The filter paper with Pana-Tetra is half thickness and penetration efficiency realizes twice.
- 2) Filtration efficiency of 90% or more is realized by 0.3 micrometer of mean-particle-diameter dust.
- 3) Pana-Tetra has the characteristic of antibacterial properties and ultraviolet absorption with the tetrapod form.

Diagram of Combination & Filtration

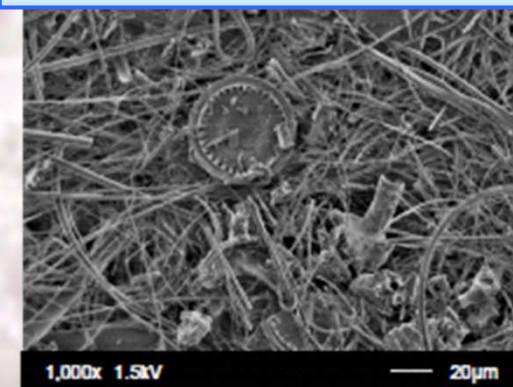


	Normal Filter	Diatomite Filter	Pana-Tetra Filter A	Pana-Tetra Filter B
Combination	0 %	40 %	40 %	63 %
Filtration	56 %	71 %	85 %	94 %
Thickness	0.33 mm	0.47 mm	0.36 mm	0.43 mm

Filter with Pana-Tetra



Diatomite (Comparison)



Measuring by light absorbance



Filtering characteristics ②

Antibacterial property Dust collection filter with Pana-Tetra

Item	Method	Filter representative properties
Thickness	JIS P 8118	0.19mm
Loss	Dust PAO 0.3μm Speed 5.3m/sec	75Pa
Efficiency		95%
Strength	JIS P 8113	3 N/15mm

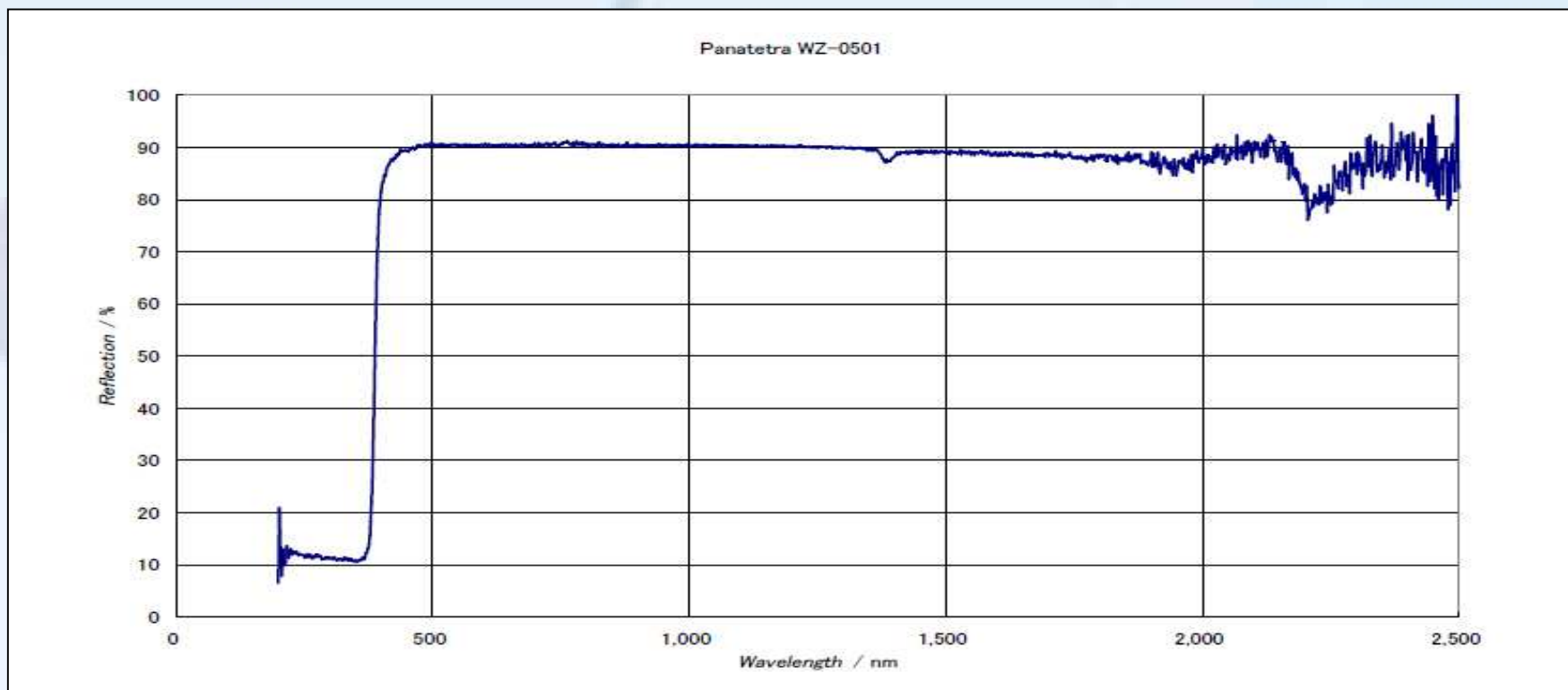


Filter photograph for air cleaners

Antibacterial evaluation (JISL1902)

Antibacterial agent	Bacillus type	Number of living bacillus	
		0 hrs.	24hrs. after
MK-10	Staphylococcus aureus	1.9×10^6	<200

■ Pana-Tetra has superior ultraviolet rays absorption characteristic by absorbing ultraviolet rays (Wavelength : 375nm). In addition, it possesses the characteristic of the white powder which shows high reflectance from a visible ray to near-infrared ray.



Wavelength of Sunbeam





「Highly elastic screw lock agent」

パナテトラ®
Epoch-making form
functional special filler
Pana-Tetra

I use a highly elastic screw lock agent which is high-strength resin with Pana-Tetra.



Pana-Tetra

Feature of screw coated lock agent with Pana-Tetra

①Improvement of repetition clamping performance

- Decrement of initial torque and the return torque small in comparison with a screw coated lock agent without Pana-Tetra.
- The repetition use number of times improves in comparison with the screw coated lock agent made in other maker.



②Superior torque transmission

Frictional force in tighten the screw becomes smaller, a transmission power improves, and torque is stable. As a result, it is easy to tighten the lock screw and becomes hard to loosen in comparison with the screw coated lock agent made in other maker.

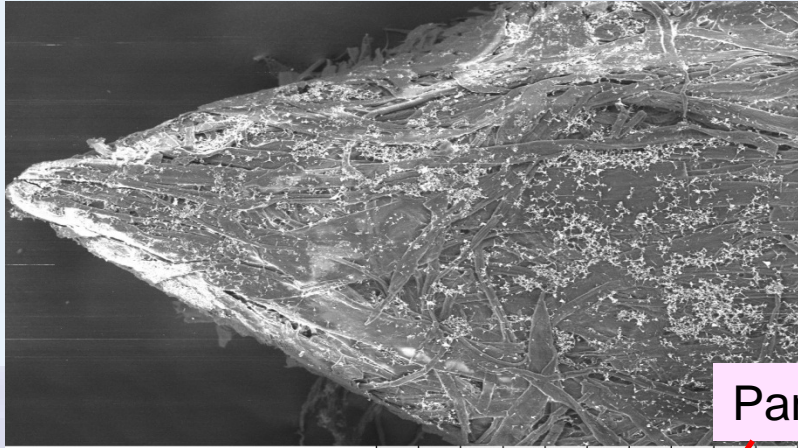


Development to the size down of the screw.

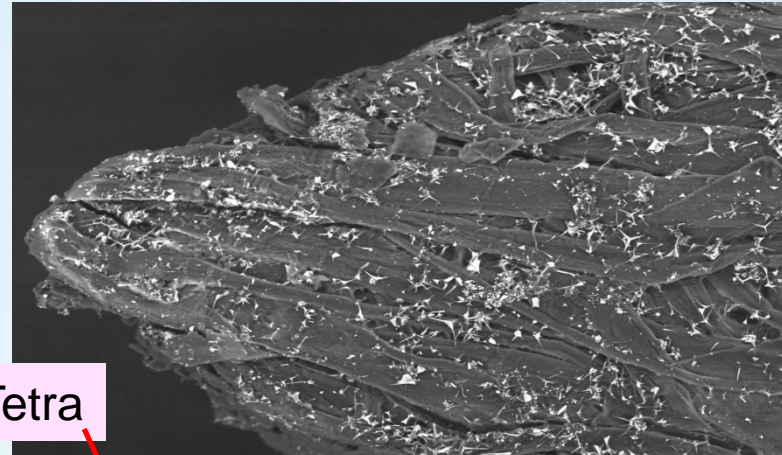
The realization of downsizing and the price reduction of the screw.



SEM photograph of film lap cutting paper blade with Pana-Tetra

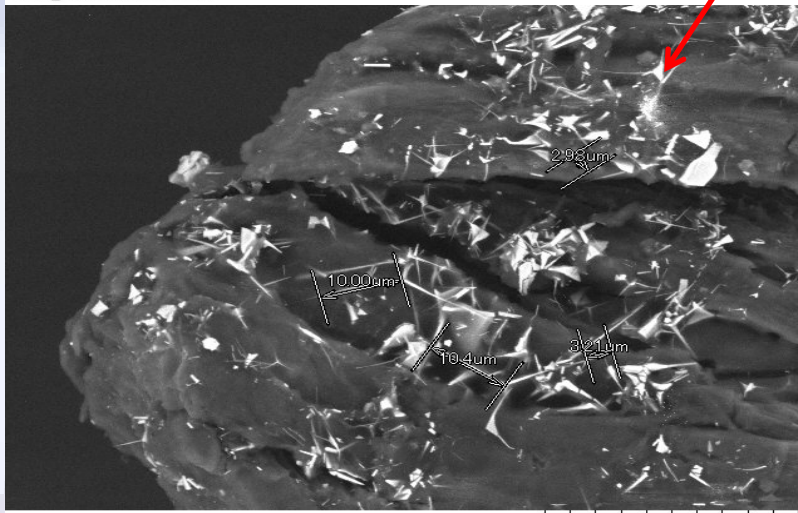


Miniscope1594 2009/10/26 14:24 500 um
Magnification=200

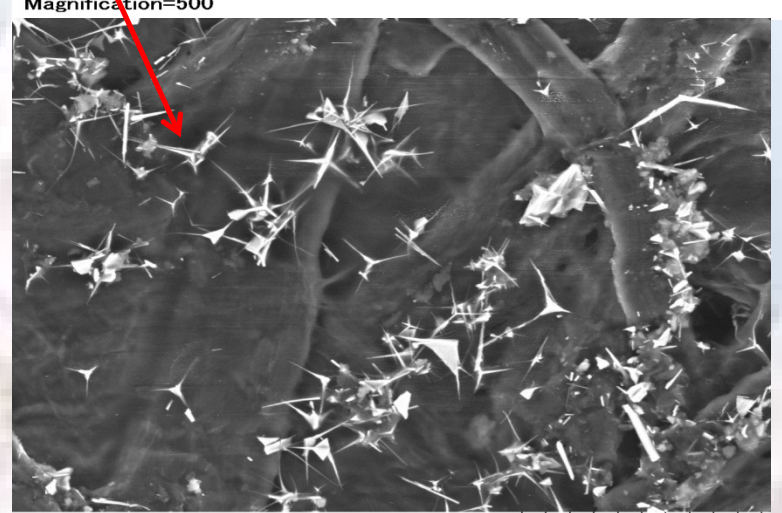


Miniscope1595 2009/10/26 14:36 L 200 um
Magnification=500

Pana-Tetra



Miniscope1599 2009/10/26 14:39 L 30 um
Magnification=2000



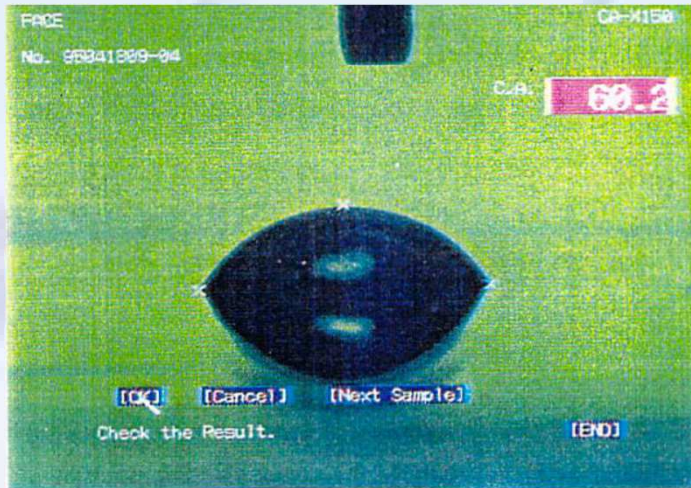
Miniscope1609 2009/10/26 14:50 L 30 um
Magnification=2000



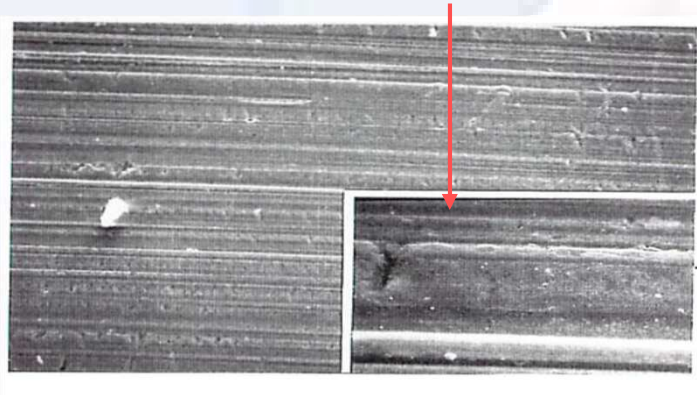
「Super water-repellent characteristic by the fractal effect」

Measurements of the Contact angle

Contact angle: 60. 2°C



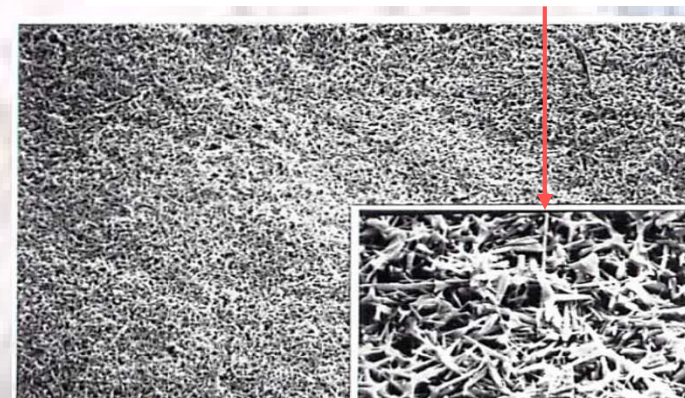
Surface of Aluminum board



Contact angle: 151. 7°C



Surface of Pana-Tetra paint





Comparison with General Zinc Oxide

パナテトラ®
Epoch-making form
functional special filler
Pana-Tetra

Item	Pana-Tetra	General Zinc Oxide
Crystal structure	A hexagonal system (Wurtzite type)	
Shape	Tetrapod-shaped	Formless granular ・Sphere-shaped granular
Purity	Single Crystal (Purity : over 99.999 %)	Polycrystalline (Purity : over 99%)
Volume resistance ($\Omega \cdot \text{cm}$)	About 10	Over 10E10
Thermal conductivity ($\text{W}/\text{m} \cdot \text{k}$)	About 25	About 25
Average particle size (μm)	About 10 (2 ~ 50)	0.01 ~ 1.5
Application	Compound Rubber (Tire, Shoes) Improvement of braking property (Effect over 30% on ice surface) Compound in resin or paint -Antistatic additional effect -Size precision improvement -Abrasion-resistant improvement -Thermal conductivity improvement	Compound Rubber : vulcanization accelerant (No effect of braking property) Electronic materials (Ferrite etc.) Cosmetic : UV cuts Paint : Color (white) Medical : antiphlogistic

Dissolution

Water / Ethanol ⇒ Not dissolve

Acid / Alkali ⇒ Dissolve (in a short time)

Characteristic

⇒ If a person eats Pana-Tetra, it dissolves in the stomach
and If a person beathes Pana-Tetra ,it dissolves in the secretion
enzyme from lungs.

⇒ Pana-Tetra does not accumulate in the human body.

⇒ Pana-Tetra is safe from the human body.