# Newstar®

## Meta-aramid Fiber

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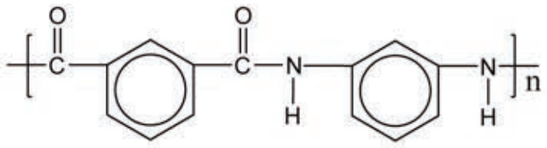
YANTAI TAYHO ADVANCED MATERIALS CO.,LTD

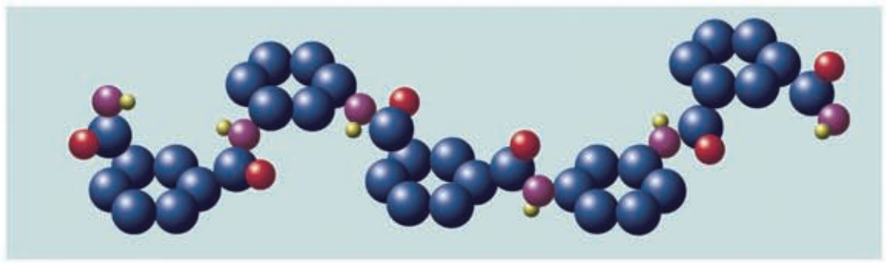
## 1.1 About Newstar®

Newstar® is the registered trade mark for the meta-aramid fiber of Yantai Tayho Advanced Materials Co., Ltd. The full name of meta-aramid is polymetaphenylene isophthamide, abbreviated as PMIA. It exhibits numerous excellent properties such as good heat resistance, flame resistance, electrical insulation, resistance to chemicals, radiation resistance, good textile properties, etc.

Molecular Formular of Newstar® Meta-aramid

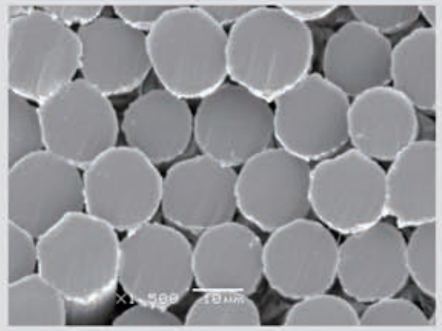



Molecular Three-dimensional Structure of Newstar® Meta-aramid






Cross Section Photograph of Newstar® Meta-aramid



## 1.2 Specification of Newstar®

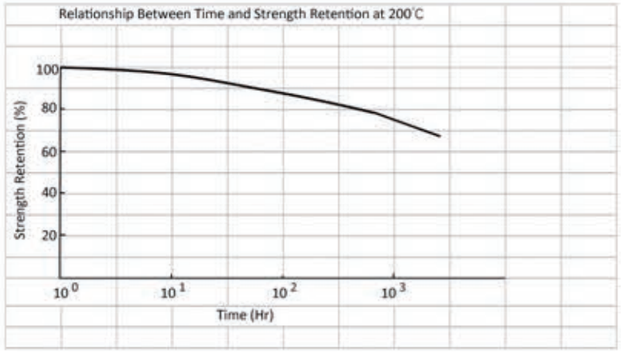
| | | |
|---|---|---|
| Density($g/cm^3$) | | 1.37 - 1.38 |
| Glass Transition Point (℃) | | 270 |
| Carbonization (℃) | | 400 |
| Specific Heat at 20 ℃, (KJ/(Kg.℃)) | | 42 |
| Conductivity at 50MHZ | 60 ℃ | 4.0 - 4.5 |
| | 180 ℃ | 5.5 - 6.2 |
| Limited Oxygen Index (%) | | ≥ 28 |

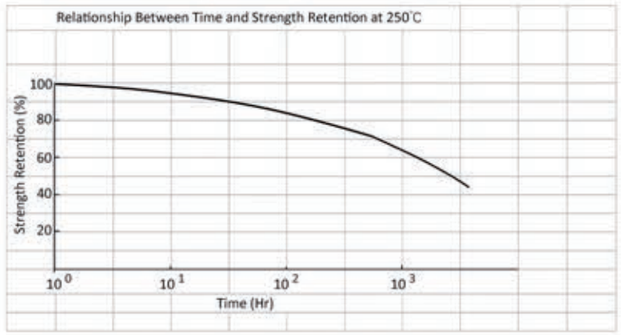
## 2.1 Heat Resistance

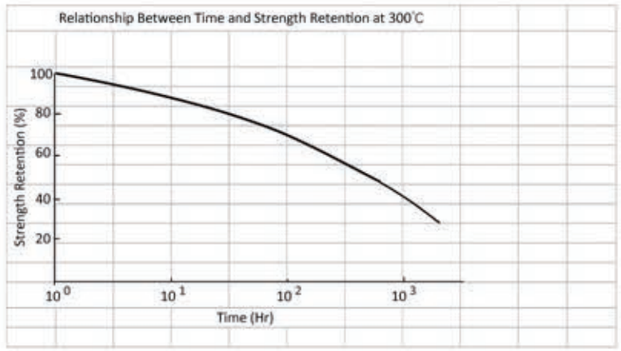
Newstar® Meta-aramid fiber offers outstanding heat resistance, being resistant to melting even after many hours of exposure to heat.

1. Effect of Dry Heat

The relationship between time and strength retention for Newstar® Meta-armid exposed to temperatures varying from 200 ˚C to 300 ˚C is shown below.

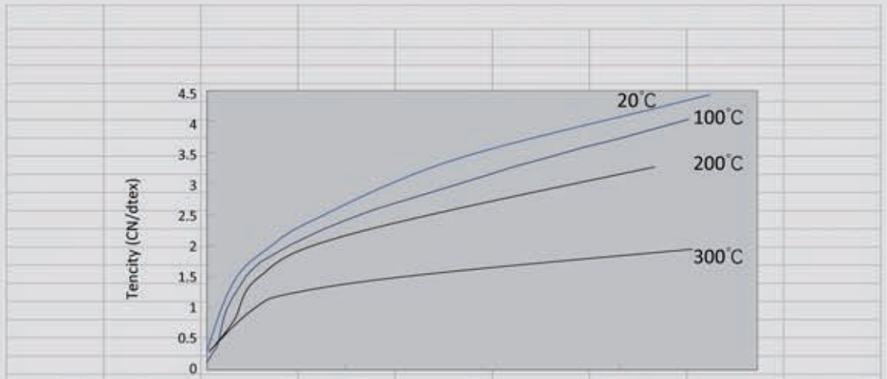


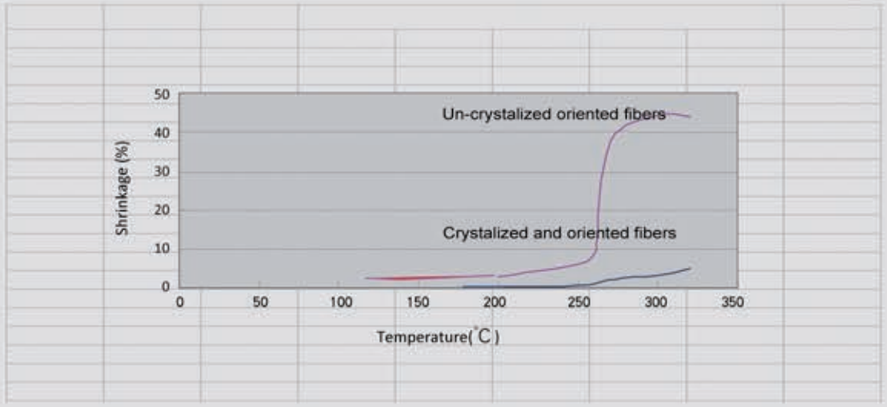

2. Fiber Properties at High Temperatures

The Stress-strain Curves of Newstar® Meta-aramid




3. Glass Transition Temperature

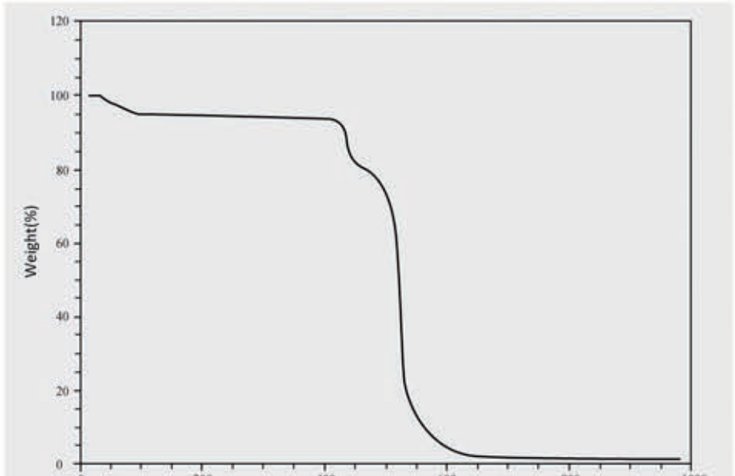
The Relationship between Crystallinty and Shringkage




The curves show that the glass transition point of Newstar® Meta-aramid fiber is about 270˚C.

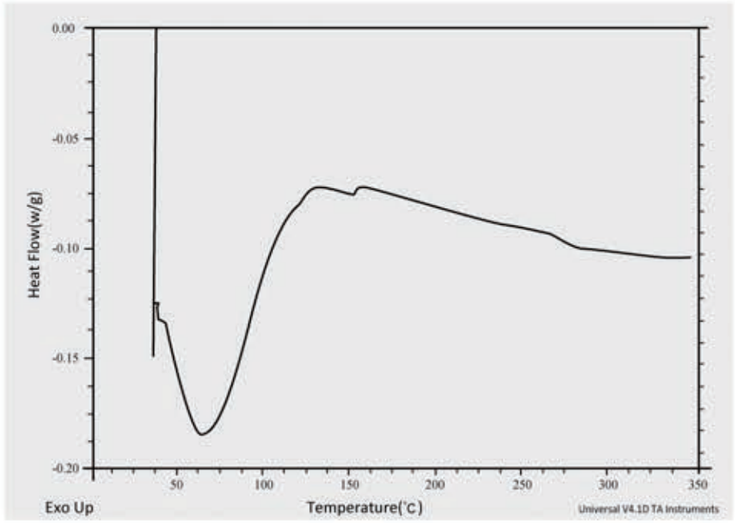
4. TGA and DSC Curves of Type N600

Thermogravimetric Analysis of Type N600 in Air




Thermogravimetric Analysis（TGA）of Type N600 shows less weight loss up to 400℃. The rapid decomposition temperature is approximately 450℃.

Differential Scanning Calorimeter Curve of Type N600 in Nitrogen




Newstar® does not melt at high temperatures.The Differential Scanning Calorimeter (DSC) curve for Type N600 does not show a defined melting point.




## 2.2 Flame Resistance

The Limiting Oxygen Index (LOI) of Newstar® Meta-aramid fiber is over 28%. It is a flame resistant fiber that will not burn, melt or drop in the air.

Vertical Flammability Tests on Fabrics of S101

| Fabric | Gram Weight ($g/m^2$) | Char length(mm) | | Char length(mm) | |
|---|---|---|---|---|---|
| | | Average of warp direction | Average of fill direction | Average of warp direction | Average of fill direction |
| S101 Orange | 200 | 45 | 40 | 0 | 0 |
| S101 Navy Blue | 223 | 44 | 47 | 0 | 0 |

## 2.3 Electrical Insulation

Newstar® Meta-aramid has good insulating property.Metastar® paper made of Newstar® Meta-aramid reaches insulation Class H and is widely used to make high grade transformers, electrical insulation motors and etc.

Properties of Metastar® Meta-aramid Paper

| Test Items | | Unit | Numeral | Standard FI3-2004 |
|---|---|---|---|---|
| Thickness | | mm | 0.065 | 0.048-0.066 |
| Basis Weight | | $g/m^2$ | 46.9 | ≥35.9 |
| Density | | $g/cm^3$ | 0.72 | ≥0.61 |
| Tensile Strength | MD | N/cm | 25.4 | ≥32 |
| | CD | | 18.5 | ≥13 |
| Elongation | MD | % | 5 | ≥5.7 |
| | CD | | 5 | ≥4.2 |
| Shrinkage at 300 ℃ | MD | % | 7.2 | / |
| | CD | | 7.5 | / |
| Tear Strength | MD | N | 1.5 | / |
| | CD | | 1.4 | / |
| Dielectric Strength | | kV/mm | 17.7 | ≥13 |
| Relative Dielectric Constant | | / | 1.1 | <1.6 |
| Electric Wasted Factor | | / | 0.004 | 0.004 |

FI 3-2004 is a standard of American National Standard Institute (ANSI) for aramid paper.

## 2.4 Chemical Resistance

Newstar® Meta-aramid exhibits very good resistance to many chemicals. It is resistant to most strong inorganic acid and shows excellent resistance to alkalis at room temperature.

Chemical Resistance of Newstar® Type N600

| Name of Chemicals | | Concentration (%) | Temperature (°C) | Time (hrs) | Retention of Strength (%) 100~91 | 90~76 | 75~56 | 55~21 | 20~0 |
|---|---|---|---|---|---|---|---|---|---|
| Acid | Hydrochloric Acid | 10 | 95 | 10 | | | | o | |
| | | 20 | 50 | 24 | | o | | | |
| | | 35 | R.T. | 10 | o | | | | |
| | | 35 | R.T. | 200 | | o | | | |
| | Nitric Acid | 10 | R.T. | 100 | | o | | | |
| | | 30 | R.T. | 100 | | o | | | |
| | | 30 | 50 | 24 | | | | o | |
| | | 60 | R.T. | 100 | | o | | | |
| | Hydrofluoric Acid | 1 | R.T. | 190 | o | | | | |
| | | 10 | R.T. | 720 | o | | | | |
| | | 10 | 50 | 600 | | o | | | |
| | | 30 | R.T. | 360 | o | | | | |
| | Sulfuric Acid | 5 | 95 | 100 | | o | | | |
| | | 20 | 50 | 750 | | | | o | |
| | | 60 | R.T. | 1000 | | | | o | |
| Alkali | Ammonium Hydroxide | 20 | 50 | 650 | o | | | | |
| | | 20 | 50 | 750 | o | | | | |
| | | 20 | 50 | 1000 | o | | | | |
| | Sodium Hydroxide | 5 | 75 | 100 | o | | | | |
| | | 40 | R.T. | 1000 | | | | o | |
| Oxidizing and Reducing Agent | Sodium Hypochlorite | 0.4 | 20 | 10 | o | | | | |
| | | 10 | 50 | 90 | o | | | | |
| | | 10 | 50 | 210 | | o | | | |
| | Sodium Chlorate | 0.5 | 50 | 500 | o | | | | |
| | Hydrogen Peroxide | 0.5 | R.T. | 1000 | o | | | | |
| Acetone | | 100 | R.T. | 1000 | o | | | | |
| Benzene | | 100 | R.T. | 1000 | o | | | | |

## 2.5 Textile Properties

Newstar® Meta-aramid fiber's low stiffness and high elongation provides excellent textile properties and characteristics, allowing processing on all types of conventional textile equipments. The staple fiber can be processed into yarns or blended with other fibers for the manufacture of knitted or woven fabrics as well as non-woven fabrics.

Properties of Spun Yarns Manufactured from Newstar® Type N600

| Items \ Yarn Count | $10^S/1$ | $20^S/1$ | $25^S/1$ | $30^S/1$ | $32^S/1$ | $40^S/1$ | $35^S/1$ | $60^S/1$ | $80^S/1$ |
|---|---|---|---|---|---|---|---|---|---|
| Twists (turns/10cm) | 42 | 62 | 65 | 70 | 68 | 80 | 82 | 125 | 160 |
| Yarn Strength (CN) | ≥1450 | ≥700 | ≥550 | ≥450 | ≥400 | ≥280 | ≥380 | ≥175 | ≥135 |
| **Items \ Yarn Count** | $10^S/2$ | $20^S/2$ | $25^S/2$ | $30^S/2$ | $32^S/2$ | $40^S/2$ | $42^S/2$ | $20^S/3$ | $40^S/3$ |
| Twists (turns/10cm) | 42 | 60 | 69 | 72 | 75 | 80 | 82 | 54 | 81 |
| Yarn Strength (CN) | ≥3000 | ≥1500 | ≥1200 | ≥1000 | ≥950 | ≥700 | ≥700 | ≥2500 | ≥1100 |

## 2.6 Radiation Resistance

Newstar® Meta-aramid fiber shows good resistance to α, β and ultraviolet radiation. For example, when Newstar® fiber is exposed at 1000Mrad of β radiation accumulation, it shows no loss of strength.

## 2.7 Technical Specifications

Specifications of Newstar® Meta-aramid Fiber (Taking N601 2.0D as an example)

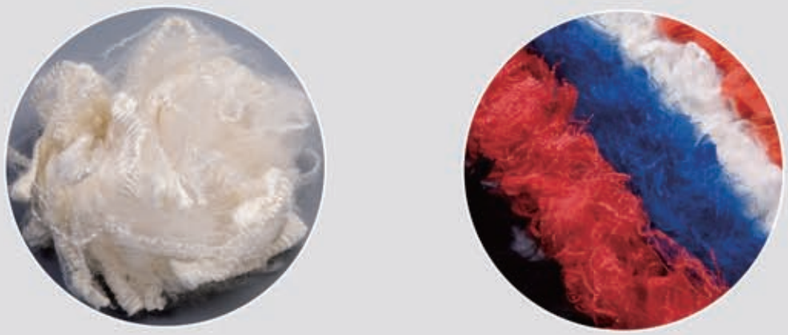
| Items | Unit | Norms |
|---|---|---|
| Titre | Denier | 2.0 |
| Tensile Strength | g/d | 3.5-6.0 |
| Elongation | % | 25-40 |
| Initial Modulus | g/de | 30-70 |
| No. of Crimps | N/cm | 4-5 |
| Moisture Regain (20 °C×65% R.H.) | % | 4.6-5.0 |
| Dry Heat Shrinkage (300 °C×15 mins) | % | ≤5 |

## 3.1 Newstar® Staple Fiber

Newstar® staple fiber is available in raw white color and solution dyed colors.

Types and End Uses of Newstar® Meta-aramid Fiber Products

| Fiber Type | | Availability | Description | Primary End Uses |
|---|---|---|---|---|
| Raw White Staple Fiber | N600 | 0.8D,1.0D,1.3D,1.5D,1.7D, 2.0D,3.0D with cut lengths of 38mm,51mm,76mm,85mm | Natural bright luster staple fiber<br>High crystallinity<br>High strength<br>Low dyeability<br>Numerous varieties | High strength spun yarns used for sewing thread, protective apparel, zipper tape, narrow fabrics, underwear, etc. |
| | N601 | 0.8D,1.0D,1.3D,1.5D,1.7D, 2.0D,3.0D, 5.0D,8.0D,10D,12D,13D with cut lengths of 38mm,51mm,76mm,85 mm,102mm | Natural bright luster staple fiber<br>Low dyeability<br>Full range of varieties | High temperature filtration , insulation materials, high temperature conveying felt, etc |
| | N602 | 0.8D,1.0D,1.3D,1.5D,1.7D, 2.0D with cut lengths of 38mm,51mm, 76 mm,85mm | Natural bright luster staple fiber<br>Good dyeability<br>Good color fastness | Protective apparel, Flame-resistant Furnishings, etc. |
| | N602-2 | 0.8D,1.0D,1.3D,1.5D,1.7D, 2.0D with cut lengths of 38mm,51mm, 76 mm,85mm | Natural bright luster staple fiber<br>Low strength<br>Good dyeability<br>Good color fastness | Protective apparel, Flame-resistant Furnishings, etc. |
| Solution Dyed Fiber | | 0.8D,1.0D,1.3D,1.5D,1.7D, 2.0D,2.5D,3.0D, 5.0D with cut lengths of 38mm,51 mm, 76 mm,85 mm,102mm | Staple fiber in a range of solution dyed colors<br>High crystallinity<br>High tenacity and medium elongation | Protective apparel, Flame-resistant Furnishings, etc. |



■ Newstar® Raw White Staple Fiber and Solution Dyed Staple Fiber





■ Newstar® Raw White Filament

## 3.2 Newstar® Filament

Newstar® raw white filament is available in 200d/100f, 1200d/600f and 1600d/800f. It is of high tenacity in natural bright luster, being the ideal material for protective apparel, electrical insulation, rubber reinforcement, etc.

■ Tametar® Electroconductive Fiber

## 3.3 Tametar® Electroconductive Fiber

Tametar® Electroconductive fiber is available in 1.3d, 1.5d, 1.7d, 2.0d, 2.5d, 3.0d with cut lengths of 38mm, 51mm, 76mm, 85mm and 102mm. It has high tenacity, good textile property and excellent conductivity. The specific resistance is $10^4$ Ω•cm at room temperature. Its excellent flame resistance and mechanical property make it ideal for protective apparel as well as industrial applications.

# 4 Applications of Newstar® Meta-aramid

Newstar® Meta-aramid is integrity of many excellent properties including high temperature resistance, inherently flame resistance, electrical insulation, corrosion resistance, radiation resistance and good spinnability. It is playing irreplaceable roles in many areas.

## 4.1 Personal Protection

Personal protective fabrics made of Newstar® does not burn, melt or bring poison gas. It is widely used in metallurgy, construction, vessel building, petroleum industry, chemical industry, automobiles, electrical power, gas industry and special protective apparel for fire-fighters, military and policemen, racing drivers, etc.

- Firefighting Apparel
- Arc Protection Apparel
- Protective Apparel for Welding Workers