

Ensinger-Hyde Introduces Hydel[®] ESD Thermoplastic Stock Shapes with Fibril[™] Nanotube Technology



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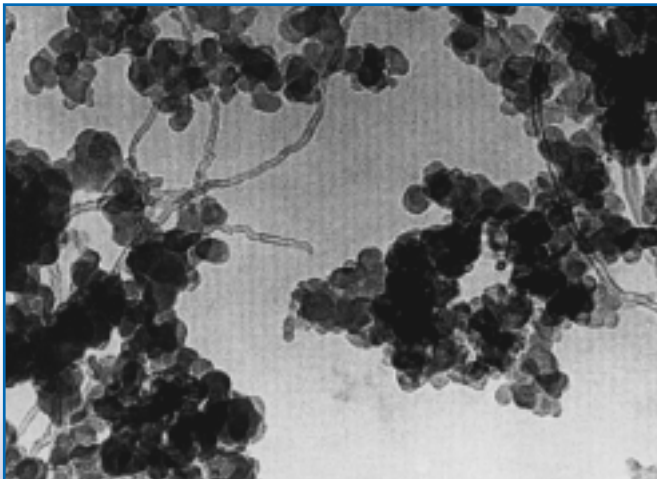
Ensinger-Hyde's Hydel[®] thermoplastic stock shape materials will allow users in the electronic and electrical industries to produce fabricated parts with the highest level of ESD control available. These new materials, **Hydel[®] PC-7** (polycarbonate) and **Hydel[®] PEI-7** (polyether-imide, Ultem[®]) are thermoplastic resins filled with a new microscopic form of carbon called "**Fibril[™]**" nanotubes". 1/1000th the size of conventional carbon fibers, these new graphitic **Fibril[™]** nanotubes are hollow and curved graphite microfibers that

are 0.01 micron in diameter. Because of their contour and microscopic size—even smaller in diameter than carbon black particles—**Fibril[™]** nanotube filled **Hydel[®] PC-7** and **Hydel[®] PEI-7** provide ESD users with outstanding properties for ESD control, mechanical strength, and cleanliness.

Hydel[®] PC-7 and Hydel[®] PEI-7 Features:

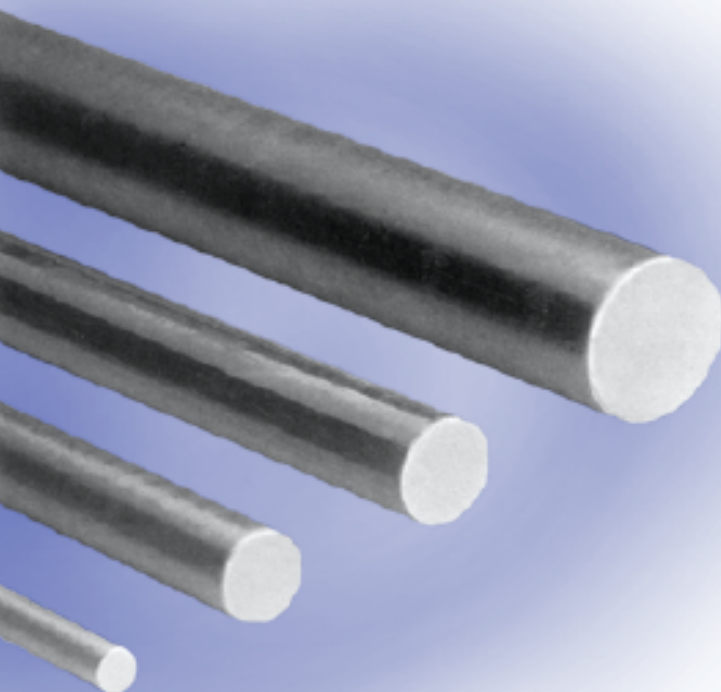
Minimal Carbon Content: While providing the optimum surface resistivity range of 10^7 ohms/sq., the carbon content in **Hydel[®] PC-7** and **Hydel[®] PEI-7** is 75% less than that of competitive materials that are filled with conventional carbon fibers or carbon powder. This substantially lower loading level translates into minimal sloughing and crayoning problems for particulate-conscious end users. **Hydel[®] PC-7** and **Hydel[®] PEI-7** are currently being used in clean room environments by many electronic industry end users.

Zero Residual Charge: The extremely high conductivity of graphitic **Fibril[™]** nanotubes provides **Hydel[®] PC-7** and **Hydel[®] PEI-7** users with the assurance that all charges will effectively decay to zero residual charge.

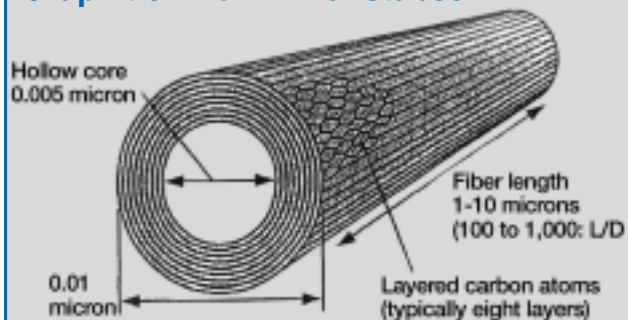


Graphitic **Fibril[™]** Nanotubes shown with carbon powder particles. Magnified 62,500 times.

Photos courtesy of Hyperion Catalysis International



Graphitic Fibril™ Nanotubes



Uniform Filler Dispersion – No Hot/Cold Spotting:

Fibril™ nanotubes have an extremely low bulk density. This allows them to disperse very evenly throughout the base resin and minimize areas of dramatically higher or lower electrical resistivity.

Superior Toughness: Because they are curved and smaller than any other carbon filler, **Fibril™** nanotubes do not degrade the impact properties of the base resin in which they are compounded. Where conventional carbon

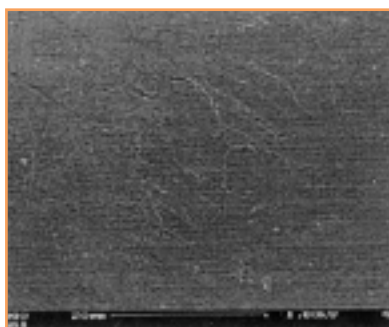
fibers and carbon powder significantly degrade toughness, **Fibril™** nanotube filled compounds maintain over 90% of the notched Izod impact strength of the unfilled base resin.

Low Warpage: **Hydel® PC-7** and **Hydel® PEI-7** exhibit the lowest warpage of any powder or fiber-filled stock shape material. Due to the microscopic size and curvature of **Fibril™** nanotubes, they do not orient during processing like conventional fibers. Parts machined from **Hydel® PC-7** and **Hydel® PEI-7** stock shapes maintain their flatness and critical dimensions even without the use of secondary annealing processes.

Superior Machined Surface Finish:

Conventional carbon fibers often bunch up during processing and form voids that are exposed during machining. Microscopic **Fibril™** nanotubes remain dispersed during thermoplastic processing and yield the optimum machined surfaces. **Hydel® PC-7** and **Hydel® PEI-7** can be machined to surface finishes of less than 4 micro inches RMS.

Component surfaces magnified 2000 times



Fibril™ Nanotubes filled resin (on left) shows consistent dispersion and excellent surface quality.



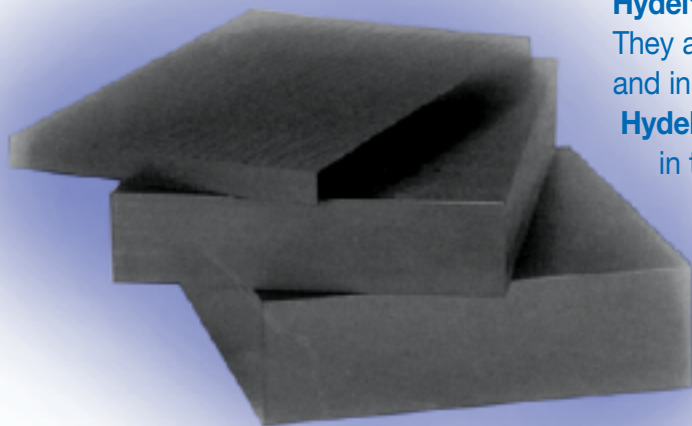
Conventional carbon fiber filler (on right) shows rough surface and individual fiber pull out.

Photos courtesy of Hyperion Catalysis International

Hydel® PC-7 and **Hydel® PEI-7** are both black in color. They are available in rods from 1/4" to 4" diameter and in heavy gauge plate from 1/4" to 3" thick.

Hydel® PC-7 and **Hydel® PEI-7** are also available in tubular bar and profiles.

Ensinger-Hyde is currently developing other thermoplastic materials with graphitic **Fibril™** nanotube additives. Please feel free to contact either Ensinger-Hyde or your local Ensinger-Hyde distributor with inquires that you may have about these alternate materials.



ENSINGER-HYDE

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