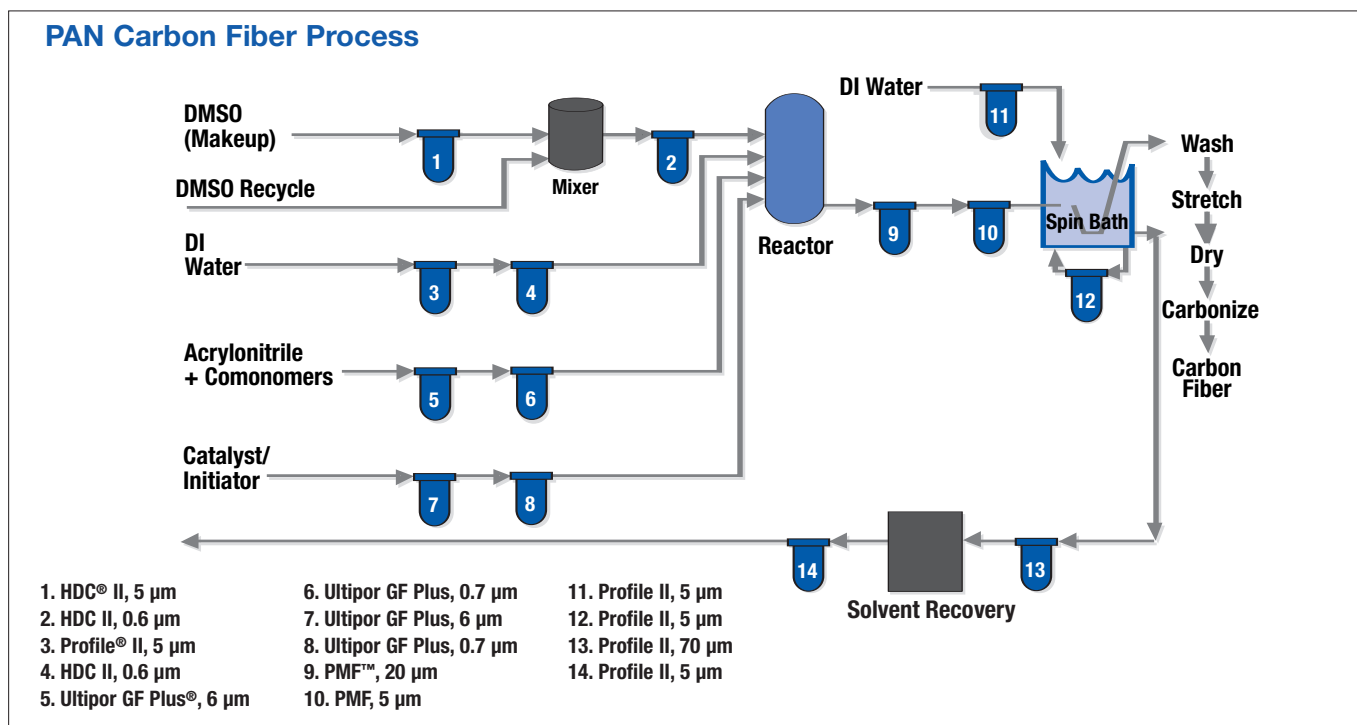


## Carbon Fiber and Pan Precursor Production



### Production Process

Carbon fiber, a lightweight, strong engineering material, is produced by either melt or solution spinning Polyacrylonitrile polymer. The Polyacrylonitrile (PAN) precursor must be pure and free of fine particulate contamination in order for the resulting fiber to possess the very high tensile strength and stiffness desired. Particulate matter present in the PAN precursor has a direct effect on weakening the carbon fiber.

The production of PAN based carbon fibers having tensile strength as high as 1 MPa and Modulus of 35-42 MPa has become possible partially due to reliable fine filtration being present throughout the process. The need to develop carbon fiber suitable for numerous very critical aerospace applications has made process fluid filtration and PAN dope filtration increasingly more important.

Numerous disposable filter applications exist in the PAN carbon fiber precursor producing process. All monomer and comonomer streams, including acrylonitrile, need to

be filtered to submicron levels, typically 0.2 – 0.6 micron ( $\mu$ m) absolute, prior to being fed to the polymerizing reactor. The actual monomers and comonomers to be filtered will depend on the specific producer's proprietary PAN process. Other feedstock streams may include demineralized water, initiator, additives, aqueous streams such as sodium chlorate, or solvent such as DMSO. These streams, as well, need to be filtered down to 0.2 – 0.6  $\mu$ m absolute prior to entering the reactor.

Since such ultrafine filtration is needed for each reactor feed stream, appropriate prefiltration will be required to first eliminate larger particles. In each case a prefilter stage will be recommended in the range of 2 – 6  $\mu$ m absolute. Preceding this, another filter rated at 20  $\mu$ m absolute will also be recommended. These prefilters reduce the particulate loading to the critical final filters. The result is *balanced filtration* for long life onstream, economy of use, and most important, the removal efficiency required to produce high quality carbon fiber.

## Pall Recommendations

**1. Reactor feed stream** final position filters (monomers, comonomers, aqueous streams, solvents, initiator, additives) depending on the process and customer requirements, either 0.2 µm absolute rated Ultipor® disposable cartridge grade NAEY, 0.6 µm absolute rated HDC® II disposable cartridge grade J006, or Ultipor GF® disposable cartridge grade U007 is recommended.

**2. Prefiltration of reactor feed streams** (monomers, comonomers, aqueous streams, solvents, initiators, additives). Two stages of prefiltration are typically recommended. These prefilters are rated 2 – 6 µm absolute preceded by 20 µm absolute. Where fluid compatibility permits, Polypropylene Profile® II is recommended. For monomers such as acrylonitrile, HDC II or Ultipor GF Plus can be used at ambient temperature with Nylon Profile being recommended at operating temperatures moderately.

**3. For batch operating systems**, holding tank vents use HDC II filters utilizing J006 grade medium.

**4. Polymer filtration** may require one or two stages depending on the customer's experience, preference, and his specific process. For example, PAN in DMSO solution polymer can require filtering with PMF™ grade FH200 (rated 20 µm absolute) followed by PMF grade FH050 (rated 5 µm absolute) filters. All streams preceding the reactor should be filtered using Pall disposable cartridges as recommended above. It is important to stress the need for efficient upstream filtration to reduce the particle loading of the downstream fine polymer filters.

**5. For the final position PAN filtration** prior to fiber spinning, Pall high pressure elements are employed. PMF elements rated 5 – 10 µm absolute in segment or pleated form are utilized to remove any residual impurities or gels in the PAN prior to fiber production.



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