ENGINEERED
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TECHNOLOGY

CFF ACRYLIC PULPS / FIBRILLATED FIBERS FOR WET-LAID / SLURRY PROCESSES

CFF® acrylic pulps* offer a number of unique advantages in specialty wet laid and slurry applications. CFF fibrillated fibers were developed to serve as high-efficiency binders in addition to providing other engineering attributes to technical papers, filter media, nonwovens, speaker cones, pulp molded products and specialty composites.

CFF fibrillated fiber pulp is produced by unique technology incorporating a special grade wet spun acrylic fiber precursor, and is fibrillated in a customized refining process. The architecture of the pulp, which is obtained by controlling the combinations of fiber length and degree of fibrillation, distinguishes CFF as a uniquely engineered fiber.

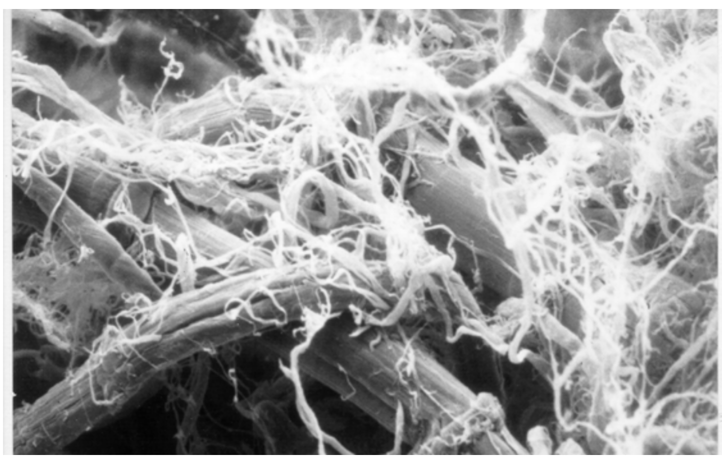

FIG. 1: CFF FIBRILLATED FIBER STRUCTURE

As shown in Figure 1, CFF fibrillated fiber has a treelike structure with a main fiber and various size limbs and branches attached to this main trunk. The trunk fiber is about 20 microns in diameter with smaller macro fibrils and fibrils ranging down to a few microns. Very fine micro fibrils which are near micron in size can be created with sufficient processing which is unique for a synthetic pulp.

CFF is a Registered Trademark of Sterling Fibers. CFF Fibrillated Fibers are manufactured by Sterling Fibers in Conjunction with EFT.

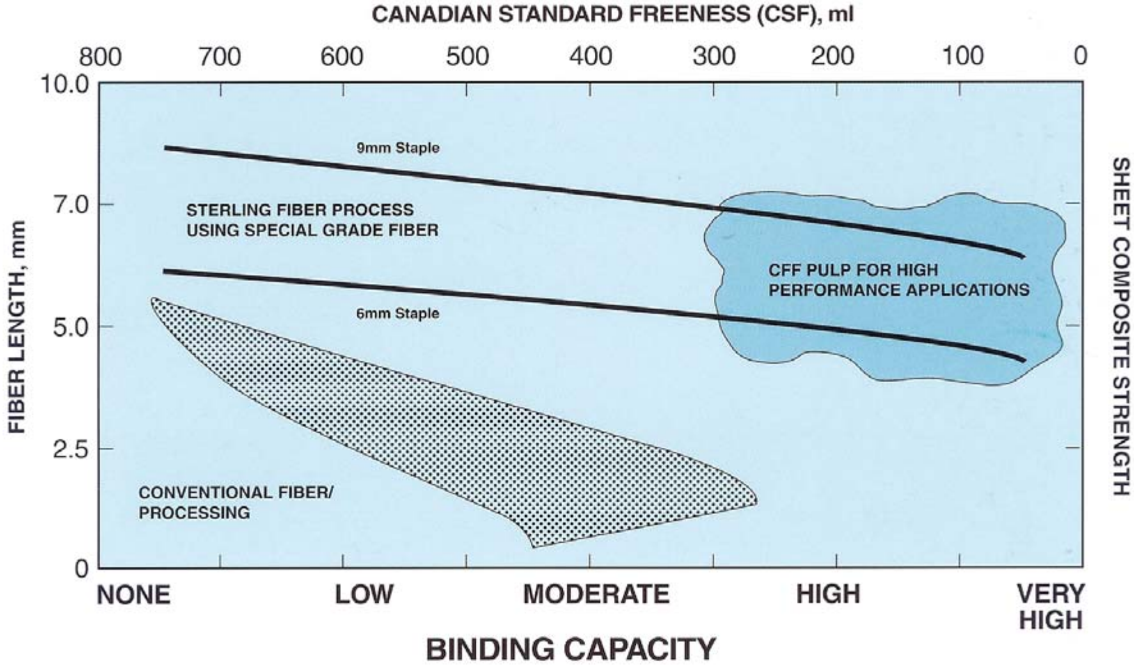

Figure 2: CSF Versus Fiber Length for Conventional and CFF Acrylic Pulps

CFF pulp provides both the very high degree of fibrillation and the fiber length required for high-performance nonwoven and specialty composite applications. This long, highly fibrillated fiber cannot be achieved with conventional refining techniques traditionally used with standard acrylic fibers. A comparison of processes is shown in Figure 2.

CFF wet pulps are being used in wet laid paper processes for interlocking other organic and inorganic fibers as well as various powders, such as aramid, carbon, etc. CFF 106-3 pulp has a Canadian Standard Freeness (CSF) of 600 ml and a typical length of 6.5 mm. CFF 111-3 pulp has a CSF of about 250 ml and a typical length of 6.5 mm. CFF 114-3 pulp has a freeness of 60 ml and a length of about 4.3 mm. These materials are supplied at about thirty percent solids and are available in commercial quantities. CFF 125-2 has a smaller trunk diameter and shorter length for improved dispersion in low intensity hydropulpers. Other freenesses between 650 and 50 ml can also be supplied. CFF wet pulps contain no size or surface finish.

CFF Pulp Type	Solids Content, %	CSF, ml	Max,/Typical Fiber Length, mm
106-3	30	600	8.0/6.5
111-3	30	250	8.0/6.5
114-3	30	60	6.0/4.3
125-2	50	400	5.5/3.5

Typical properties of this new generation of acrylic pulp are shown in Table 1.

TABLE 1
PROPERTIES OF CFF FIBRILLATED ACRYLIC FIBERS

Density, g/cm^3	1.17
Tensile Strength, MPa	450
Modulus, Gpa	6.0
Elongation, %	15
Typical Fiber Length, mm	4.5-6.5
Canadian Standard Freeness, ml	35-700
BET Surface Area, m^2/g	50
Moisture Regain, %	< 2.0
Surface Charge	Anionic
Appearance	Fine White Pulp

One hundred percent acrylic papers with a wide range of properties can be produced utilizing acrylic pulp alone or in combination with acrylic staple to produce an entirely synthetic paper with controlled sheet characteristics. The tensile strengths of acrylic sheets prepared from various blends of staple and pulp are shown in Figure 3. These physical properties are for binder-free one hundred percent synthetic fiber paper made from combinations of fibrillated fiber and acrylic staple without the use of any resins, adhesives, chemicals, additives, or any heat calendaring.

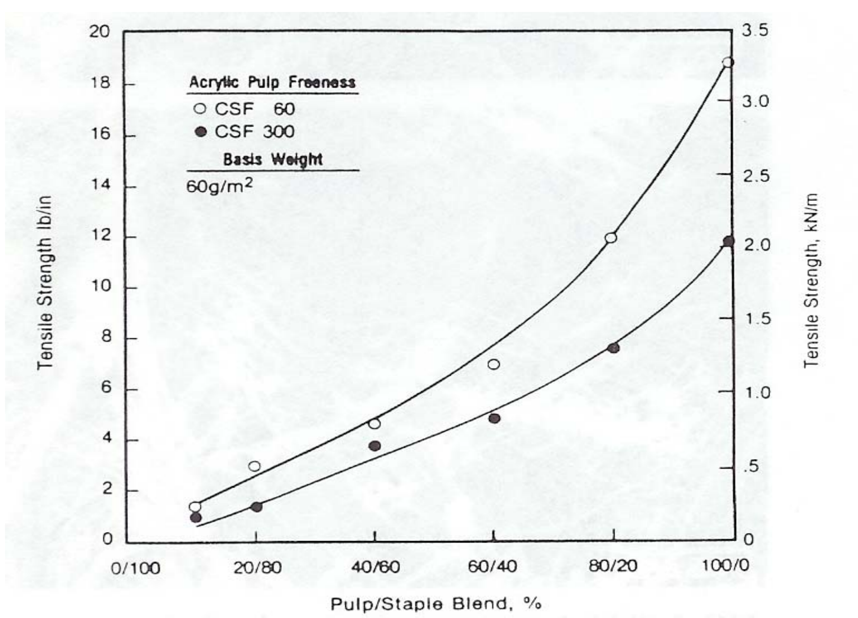

Figure 3: Tensile Strength of Acrylic Papers

Use of one hundred percent acrylic paper has advantages of exceptional wet strength, moisture resistance, dimensional stability at varying humidities, resistance to sunlight (UV), and excellent chemical resistance, to name a few. There is little difference in dry or wet sheet strength because the fibrillated fibers are mechanically entangled during drying and the fibers are then relatively insensitive to moisture.

Nonwoven filtration media can be produced without resin binders by utilizing fibrillated fiber to mechanically interlock all components of the sheet, including organic and inorganic fibers, granulars and fine powders. The use of fibrillated fiber permits the incorporation of materials not normally used in non-woven form, such as activated carbon fibers and powders. By choosing the proper degree of fibrillation of the acrylic pulp and the proper manufacturing procedure, filter paper consisting of one hundred percent fibrillated fiber can be made for the whole range of analytical filter paper requirements established for cellulosic paper. Filter paper produced from these fibers has excellent acid resistance, good alkali resistance and is insoluble in common organic solvents as discussed above. Such paper can be used for filtering many corrosive liquids or for filtering fine crystals precipitated from hot solutions. In addition, the high wet strength of the papers is of specific value for industrial filter applications.

The fibrillated acrylic pulp is also attractive for use in aerosol and HEPA filters where glass microfibers are normally used, since the fibril size of the acrylic may range to near micron or sub-micron size. Incorporation of acrylic pulp into papers containing glass microfibers has been shown to reduce shredding and improve strength. For aerosol entrapment, it is possible to make paper using one hundred percent CFF fibrillated fiber which has high DOP resistance while maintaining acceptable air flow.

Several novel nonwoven absorptive structures having high weight percent loadings of activated carbon fibers and/or activated carbon powders are possible utilizing acrylic pulp as a binder. The use of this binder fiber permits extremely high loadings of filler materials such as activated carbon powders and fibers without loss of sorptive effectiveness, because the fibrillated fiber does not block the microporous structure of the carbon. As discussed previously, the acrylic also helps to maintain good wet strength and has chemical resistance. The use of a nonwoven provides a sorptive filter media that is easy to handle and process.

Activated carbon paper bonded with fibrillated acrylic fiber has been made on various pilot and production paper machines. Formulations contained active carbon in the powder form, in fiber form and as mixtures of carbon and other fibers. The acrylic pulp, active carbon and processing additives were mixed by blending in a hydropulper before batches were added to the paper machine headbox for sheet forming. A wide range of applications for acrylic pulp in nonwovens are listed in Table 2.

Table 2

SOME APPLICATIONS OF CFF ACRYLIC PULP IN SPECIALTY PAPERS/ PULP MOLDED PRODUCTS AND ENGINEERED MATERIALS

Air Filtration Media
Absorptive Media
Water Filtration Media (Papers and Slurry Molded Shapes)
Beater Add Non-Asbestos Gaskets
Combustible Shell Castings
Speaker Cones
Transmission / Friction Papers
Molded Clutch Facings
Security Papers
Ceramic / Refractory Binder (Green Strength)
Chromatographic Papers
Sealants
Honeycomb Paper
Fuel Cell Papers
Desicant Papers
Membrane Supports

CFF acrylic pulp is now being used by several speaker cone companies worldwide on a commercial basis in their slurry molding processes. Typically about 20-30 percent of CFF pulp is used either with cellulose pulps or a blend of cellulosic pulps and glass or other short synthetic fibers. These acrylic pulps enhance physical and mechanical performance, provide better acoustical / frequency response, reduce the moisture adsorption, and improve the wet strength. Cones containing CFF acrylic pulp can be hot pressed to improve surface smoothness, increase strength, reduce porosity, etc. CFF 111-3 is the most commonly used pulp because of its good balance of properties. Some of the advantages of CFF pulp are listed below.

- Ten times the binding / holding efficiency of cellulose pulps – enables Kevlar content of 40% or more
- Reduced moisture absorption
- Outstanding dimensional stability vs. relative humidity
- Increased mechanical strength and stiffness – superior wet strength
- Higher use temperature vs. thermoplastic or cellulose fiber / pulp
- Excellent lot-to-lot uniformity
- Good dispersion and wet processing

One key to successful use of our acrylic pulp is good dispersion in the slurry. EFT / Sterling Fibers can provide mixing recommendations as well as technical and processing assistance during either the laboratory, pilot machine or production scale development of products containing CFF acrylic pulps.