The Use of Lignocellulosic Fibers for Filters

Roger M. Rowell, United States Department of Agriculture, Forest Service, Forest Products Laboratory, and Biological Systems Engineering Department, University of Wisconsin, Madison, WI

We live in a water-based world. Water sculptures our landscape, provides navigational opportunities, transports our goods, and is the medium of life. It is the basis of all life on earth so it is not surprising that one of our high priorities is to insure a long-term supply of clean water.

Seventy percent of the earth's surface is covered with water. Most of this water, 97.5%, is in the oceans and seas and is too salty to drink or grow crops. Of the remaining 2.5%, 1.73% is in the form of glaciers and icecaps leaving only about 0.77% available for our fresh water supply. Said another way, of the total water on earth, only 0.0008% is available and renewable in rivers and lakes for human and agricultural use. It is the water that falls as rain or snow or that has been accumulated and stored as groundwater that we depend on for our "clean" water resource.

For 1.5 to 2.5 billion people in the world, clean water is a critical issue. It is estimated that by the year 2025, there will be an additional 2.5 billion people on the earth that will live in regions already lacking sufficient clean water. In the United States, it is estimated that 90% of all Americans live within 10 miles of a body of contaminated water. Water contaminates include sediments, nutrients, pathogens, heavy metal ions, nitrogen, phosphorus, suspended solids, and toxic organics. Other conditions to be considered for clean water include pH, temperature, habitat, and noxious plants.

The development of filters to clean our water supply is big business. It is estimated that global spending on filtration (including dust collectors, air filtration, liquid cartridges, membranes and liquid macro-filtration) will increase from $17 billion in 1998 to $75 billion in 2020.

Research at the Forest Products Laboratory and elsewhere have shown that lignocellulosic resources can remove many of these contaminates from aqueous solutions. Lignocellulosic materials are very porous and have a very high free surface volume that allows accessibility of aqueous solutions to the cell wall components. Lignocellulosics have an affinity for water, has ion-exchange capacity and general sorptive characteristics which are derived from their constituent cell wall polymers and structure. The polymers include extractives, cellulose, hemicelluloses, pectin, lignin, polyphenolics, tannins, and protein.

Biofiiber-based filter, made from many different types of lignocellulosics using several types of web technologies, have been used to remove suspended solids from storm water runoff, toxic organics from industrial waste streams, heavy metal ions from coal and hard rock acid mine drainage, nutrients from intensive fish farming, phosphorus from farm runoff, and sediments from lakes. The same lignocellulosic mats are also used as mulch mats for growing new trees and other crops and as geotextiles to help stabilize stream banks and steep construction areas.