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Kynol Activated Carbon Fibers & Textiles

Kynol 100% activated carbon materials are made directly from Kynol novoloid (phenolic) precursor fibers and textiles. Not merely coated or impregnated with carbon, they may be thought of as activated carbon in textile form.

As seen in these scanning tunneling electron (STM) images the fibers are well etched on the surface (Fig.1), with direct entry into a network of micropores extending throughout the interior of the fibers (Fig. 2). Pore-size distribution is quite sharp and well correlated with specific surface areas up to 2500 m^2/g. Fiber diameter is on the order of 10 microns, so adsorption/desorption dynamics are outstanding.

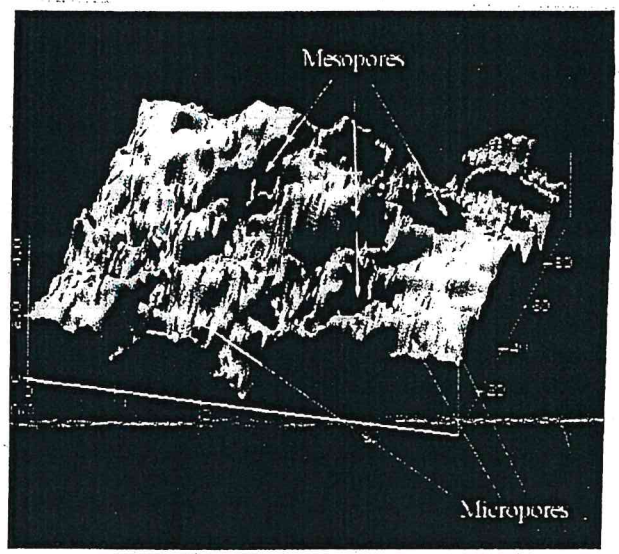


Fig.1 ACF-25, surface
Note exaggeration of Z axis.

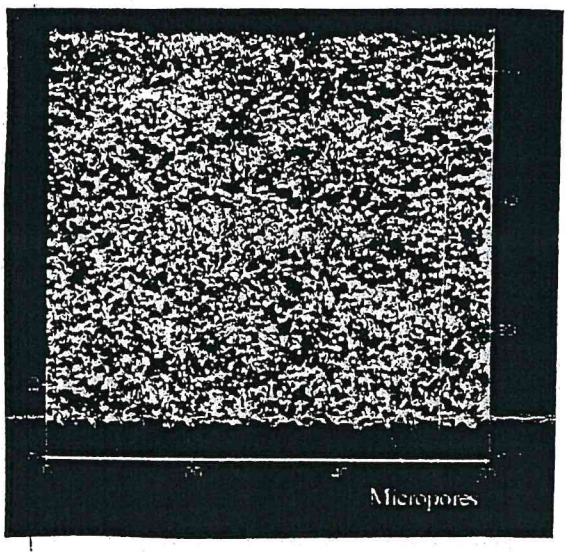


Fig.2 ACF-15, cross-section (fracture) showing pore network

(STM Images courtesy J. Economy and M. Daley, Dept. of Materials Science and Engineering, Univ. of Illinois at Urbana-Champaign)

These materials are available as fibers (milled, chopped, roving or tow), yarns (both spun and continuous), wet- and dry-laid nonwovens, papers, and woven or knitted fabrics. Applications include filtration and purification of both gases and liquids; air filters for computer components; decomposition of ozone and halogen compounds; solvent recovery; NBC-protection; and electrodes for capacitors and other electrochemical devices.

Kynol novoloid fibers and textiles are transformed into activated carbon by a one-step process combining both carbonization and activation. As in the case of carbonization, activation can be carried out using either novoloid tow or finished products such as felts and fabrics. Surface area of the activated material can approach 3000 m^2/g.

The accompanying table shows typical properties of Kynol activated carbon fibers; data for PAN- and rayon-based activated carbon fibers and for granular activated carbon are presented for comparison.
The pliability and strength of Kynol activated carbon fibers are distinct advantages.

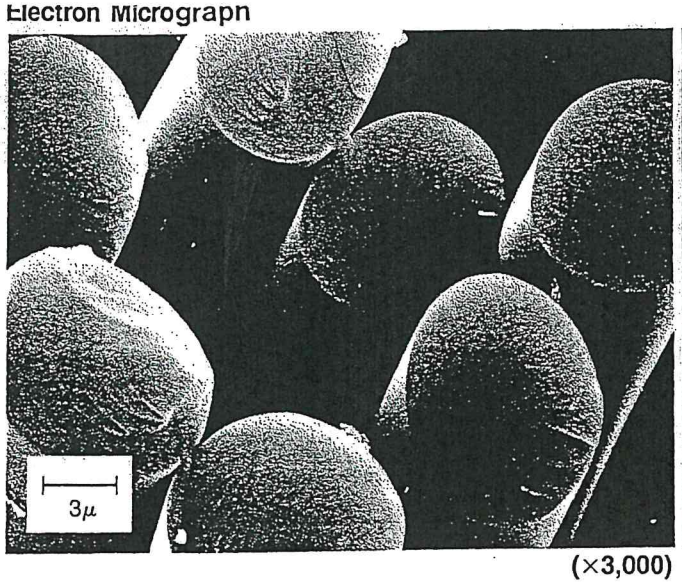
The pores of Kynol activated carbon fibers are generally uniform in size and straight, rather than branched as in granules. Pore radius and volume increase with increasing activation (surface area), and thus may be controlled for selective adsorption of polypeptides and similar large molecules. The pore configuration and high surface-to-volume ratio of the fibers, compared to granular activated carbon, permit extremely rapid and efficient adsorption and desorption.

Typical Properties of Activated Carbon Fibers

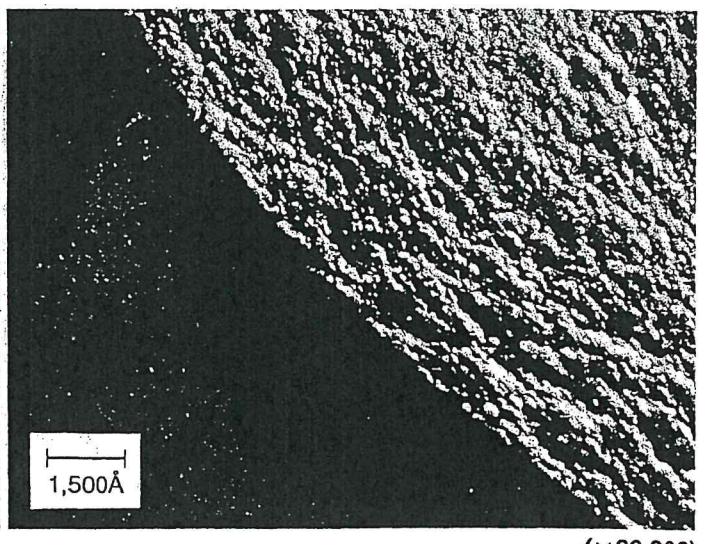
Property		Precursor				
		Novoloid	Novoloid	PAN[a]	Rayon[a]	Granules
yield, wt%		33	22	15	7	
diameter, μ		9.2	8.5	ca 5	ca 10	
pH		7.3	7.5	8.0		6.3
pore density	specific surface area[b], m^2/g	1500	2000	870, max	1450, max	910, typical
	pore volume[c], cm^3/g	0.63	0.75	0.28	0.53	0.42
mechanical properties	tensile strength, kg/mm^2	40	35	30	7	
	elongation, %	2.8	2.7	too low to measure		
	modulus, kg/mm^2	1400	1200	8000		
gas adsorption capacity at 20°C[d], wt%	benzene	53	67	34	46	33
	toluene	57	80	32	47	35
	trichloroethylene	83	104	53		61
moisture regain (20°C, 65% RH), wt%		37	20	30		27
methylene blue adsorption capacity[e], ml/g		200	300	40		100

a) Owing to their partially crystalline structure, these examples represent the practical limits of activation for these fibers. PAN = polyacrylonitrile.
b) BET method.
c) Steam-adsorption method.
d) JIS K-1474 Japan industry standard.
e) JIS K-1470 Japan industry standard.

Electron Micrograph



(×3,000)



(×60,000)

Comparative Performance of Kynol Activated Carbon Fibers (ACF) vs. Granular Activated Carbon (GAC) -- typical examples:

Dechlorination of Drinking Water (Conversion of Cl_2 to Cl^-)
(2 ppm Cl_2, 1 liter/min)

	ACF	GAC
Carbon weight (g)	4.8	24.0
Water volume treated (l) (80% or greater conversion)	2400	800

Benefits of ACF: 15 times longer filter life for the same amount of carbon.

Solvent recovery
(2000 ppm CH_3Cl_3, 100 m^3/min)

	ACF	GAC
Carbon weight (kg)	112	2800
Steam consumption (kg/h)	350	1680
Cooling water (t/h)	10	48
Outstanding concentration (ppm)	40	100
Solvent recovered (kg/h)	70	68
Acid content (HCL, ppm)	1-2	20-100

Benefits of ACF: Highly compact system with much improved dynamics of operation, resulting in reduced utilities costs, better recovery (lower emissions), significantly improved quality of recovered solvent, less corrosion, and greater safety.

