Cotton-clay composite takes the heat

By Erin K. Peabody, Agricultural Research Service Information Staff

A plain, dingy white fibre sitting in a New Orleans laboratory holds great promise. The seemingly mundane material is only steps away from becoming an innovative textile that will be known for its ability to withstand heat.

For the first time, Leslie A. White and Christopher D. Delhom, scientists at the ARS Southern Regional Research Center (SRRC) in New Orleans, are creating a new, heat-tolerant fabric by mixing cotton fibres with something you probably wouldn't expect — clay!

"This unique material could someday be used as fabric for specialty textile products, including protective apparel, and for insulation to provide fire protection in homes," says Delhom, a mechanical engineer at SRRC.

Why clay? Its naturally occurring minerals — cost-effective and readily available in pure form — enhance the flame-retardant properties of a textile and give it durability. Scientists have known this for some time, but they've never before tried pairing clay with a plant-based cellulosic material, like cotton. Not stymied by cotton's low threshold for heat, SRRC researchers are experimenting with this inherently soft basic and are finding success.

"Because cotton's melt temperature and burn temperature are the same, unlike those of a plastic, for instance, we first dissolve the cotton fibres with a solvent and then mix in the clay on a molecular level," says White. She is a chemist in SRRC's Cotton Textile Chemistry Research Unit.

Untreated cotton fibres (left), and regenerated nanocomposite fibre containing seven per cent clay.

Montmorillonite clay particles, used in some cat litters, are put into the cotton fibres as nanometer-size particles — one billionth of a metre in size. The result of this unique union, built on a microscopic scale, is known as a nanocomposite.

"Once the mixture is dried and the solvent removed, the tiny clay particles have become dispersed and embedded throughout the cotton matrix. The resultant material — made of one to 10 per cent clay, with the balance as cotton — is the basis for producing fibres with flame-retardant properties," White continues. In this way, the melding of dissimilar components creates a new material with novel properties.

The combination cotton-and-clay product has a heat tolerance of 20° to 30°C above that of unbleached cotton. White and Delhom are also evaluating the product for strength, toughness, and wear resistance. Once the material is processed into a fabric, more tests will be run.

As part of a 'green' chemistry initiative, SRRC's cotton nanocomposite project boasts the joining of two naturally occurring constituents, aided by a recyclable solvent that is applied in a closed system.

White and Delhom are investigating a range of cellulosic fibres — including those of wood, grass, leaves, and even recycled newspaper — to see whether they too assume increased flame resistance, and other desired attributes, with the addition of various types of clay.

This research is part of 'Quality and Utilisation of Agricultural Products', an ARS National Program (#306) described on the World Wide Web at www.nps.ars.usda.gov.

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"Cotton-Clay Composite Takes the Heat" was published in the April 2004 issue of Agricultural Research magazine.