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Tech Note #2: materials

### Hemp: it **IS** a structural material?

I found an article online that has uncovered a most interesting usage for that material we all know and love—hemp. Apparently, when mixed in the right proportions with lime (calcium hydroxide) and water, the silica in the hemp will harden and turn into stone! It's essentially a super-fast petrification of the organic fibers. A man named David Cull and his friends demonstrated the technique at “The 2nd International Commercial & Industrial Hemp Symposium” in 1998. They started by building a mold for the hemp-mixture to be poured into:

The framing for the two walls was assembled to demonstrate two possible construction methods. The first one was a standard 2 x 6 stud wall format, the 2nd was designed around untreated roundwood poles, in this instance mounted on a 2 x 6 bottom plate, but in the field, set carefully in the earth at 8ft centres to define the building's perimeters, closed in with sheets of plywood formwork, and packed with StoneHemp. The plywood sheets were fixed to 1" x 1" wooden batten strips nailed to both sides of the 2 x 6 studs and the roundwood posts.

They then mixed a few different recipes and poured them into the wall molds. The basic recipe is “10 parts by volume of hemp hurds, 4 parts of hydrated lime and enough water to produce a stiff, workable mix.” They also experimented with adding sand and cement powder into the mixture. The classic mixture takes a week to harden to the point where it can be drilled into. The mixture that had cement dried much faster—it set in a couple of days.

Further, Cull and his group argues that the walls which are produced are lighter, stronger, and better insulated than similarly-sized walls built out of steel reinforced concrete. Even better than that, they're *cheaper* than steel-and-concrete walls, too. Cull is also quick to point out that this technology has been around since the Romans, and he claims that they actually used natural fiber mixtures in the construction of the aqueducts.

So how come this stuff isn't in widespread use? Doing a little bit of research, I found a lab at the University of Wales that's trying to do a better job of quantifying the properties of hemp composites. Their results basically agree that such walls are stronger and lighter than standard walls, but they show that natural-fiber walls have a serious problem when it comes to *toughness*—that is, the ability to stop cracks from propagating down the wall. According to their research, they haven't found a way to keep this from being a serious problem in any of the natural-fiber walls they've tried. These fibers include flax, jute, and, yes, hemp.

So is hemp going to be replacing concrete any time soon? Probably not. Is it a material which might be interesting for stage use? Maybe it's worth looking into.

Primary source: <http://csf.colorado.edu/forums/essa/mar98/0141.html>