Hardshelling

Jim Cullen (NV) - Let's begin by acknowledging that I am not a composite structures expert. I'm a geologist by trade who happens to be two years into construction of a Cozy Mark IV. About four months ago I was lurking on the computer network, *Internet,* when I ran across a discussion group on experimental aircraft. Some memos had been exchanged on the subject of hardshelling. The consensus was that hardshelling is something that one should never do because it results in a structure that is more prone to delamination than one built with normal techniques. Having never heard the term before, I continued to read. . . . .

Hardshelling is performed by spreading micro slurry and/or dry micro over a foam core *and allowing it to cure,* prior to laying up any fiberglass. The micro is contoured to shape and, only after this has been done, the glass lay-up is performed. (On wing, spars, and canards, micro is ***never*** spread between the spar caps and the outer skin).

The logic seems to be that tighter dimensional tolerances can be maintained when contouring the micro - - the hard shell, if you will - - than can be achieved by contouring bare foam, this is especially true if the foam core is produced by a hot wire saw. The result is a finished airfoil that requires less filling. More importantly, there are fewer dips in the skin resulting in straighter glass strands and a stronger structure.

The discussion on *Internet* revolved around delamination. Would a skin laid up over a hard shell delaminate more easily than one laid up in the normal manner? The author thought that it would. He had performed some experiments and found that the skin basically just popped off the underlying dry micro. This gave me pause for concern. The bottom half of my canard and the bottom of my fuselage had been hardshelled before I had ever heard of the term. Should I scrap my work?

I called Nat Puffer to discuss the problem. Basically, he could see no advantage to the technique, as long as the core had been properly shaped and prepared, and he agreed that hardshelling might result in a higher potential for delamination. He told me not to scrap my work, but advised me to be a bit more careful in hot wiring my cores and to be a little less zealous in sanding them -- good advice for everyone.

Two weeks later, I discussed the problem with some builders at Burt Rutan's 50th birthday party in Mojave. The consensus seemed to be that hardshelling was a perfectly acceptable technique! Confusion appeared to reign amongst the experts. So, I decided to do a little of my own testing.

The photo below shows the basic test setup. A piece of polystyrene foam left over from my canard was divided into four sections. Section 1 was left bare for a normal lay-up, section 2 was covered with micro slurry and sections 3 and 4 were covered with a 1/16" thick layer of dry micro over micro slurry. In this manner, the piece was allowed to cure.

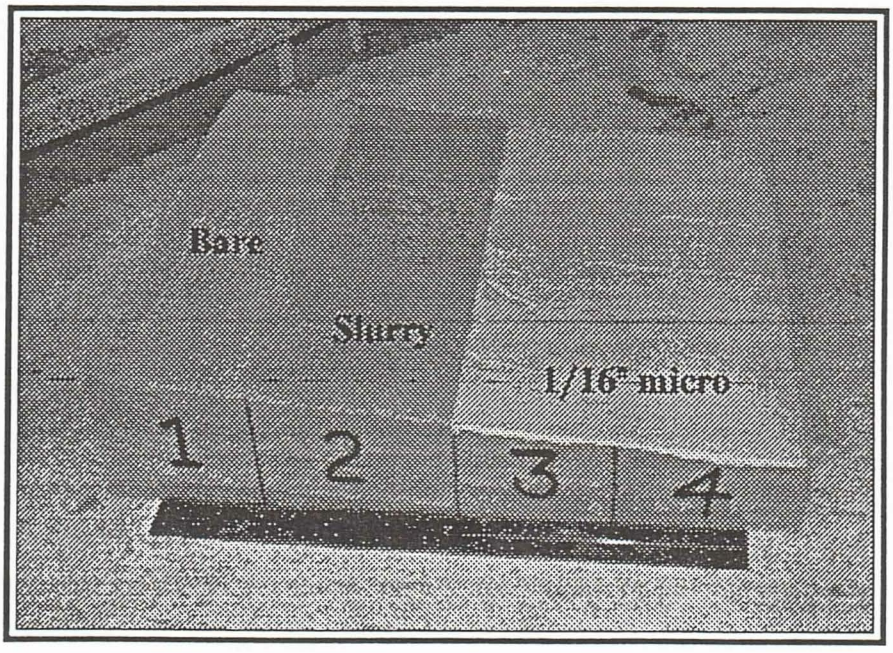
After cure, section 2 was sanded with 40 grit sandpaper. The dry micro was sanded off section 3, and the dry micro was roughed up *but not sanded off* section 4. The piece was vacuumed, painted with Saf-T-Poxy II, and a normal 2-ply BID lay-up was performed. Then the lay-up was numbered and cut into 7 sets of test coupons.

Sets 1 and 2 were peeled by hand, to obtain a qualitative feeling for potential delamination problems. The results were as follows:

Section 1 - - the normal lay-up - - delaminated at the foam glass interface with virtually no micro slurry remaining on the foam. The glass bent back slightly as it was peeled back. Small pieces of foam (1/32" or less in size) adhered to the glass. Just about every builder has tried this at one time or another; nothing out of the ordinary occurred.

Section 2 -- glass laid up over cured micro slurry - - exhibited precisely the same delamination pattern. No discernible difference in the amount of force required to perform the delamination could be detected.

Section 3 - - glass laid up over the area where the dry micro had been



sanded down to the level of the micro slurry -- also delaminated in the same way. Again, no noticeable difference in force was required to delaminate the structure.

Section 4 -- glass laid up over the 1/16" dry micro -- took considerably more force to delaminate. The dry micro adhered to the glass and delamination took place at the foam/micro slurry interface. The glass piece was noticeably stiffer -- to the point that the glass actually cracked rather than being peeled off the foam.

From this, qualitative experiment, I would have to conclude that, if anything, hardshelling results in a structure that is stronger, more resistant to delamination, and possibly stiffer than one performed using conventional lay-up techniques.

However, as I stated earlier, I'm not an expert in these matters. This article was written to foster discussion and bring out knowledge and experiences of other CSAers. Please write and tell us what you know.

if anyone has the proper facilities to measure the peel strength of my test coupons quantitatively and would like to perform some tests, the unused portions are available upon request. Anyone need a Master's thesis?

Heard at OSH

A visit to Oshkosh is a visit to a dreamland. It proves to you that just about anything can happen. Why even Jim Bede had a new airplane fly at Oshkosh 93.

Dreams were heard at every corner and in every forum. Some were plans of things never done before while others were on further development of existing ideas.

John Roncz's forward swept wing low drag homebuilt has undergone more revision and is now projected to fly with a Continental O-470. Dilley and Lombard of Featherlite have completed the fuselage tooling. It is rumored they will kill John if he makes any more revisions. The fuselage design appears to be frozen.

RAF and Scaled Composites will be moving to Montrose, Colorado during the next one and half years. The California tax and legal environment is not conducive to further growth. Montrose has offered free land and a new 10,000 foot runway as well as other incentives to encourage the move. With such visionary philosophy welcoming new tenants, many aerospace manufacturers will be moving to the Colorado community.

Burt Rutan has decided to build another little airplane. He originally wanted the Catbird to be pressurized but has found a different style fuselage to be more easily pressurized.

The new bird, called the Boomerang, will have twin fuselages located at different distances from the centerline of the wing. Power will be provided by twin front engines. The fuselages will be of different lengths and the propeller arcs will be staggered. The shorter fuselage's prop arc will be located aft of the longer fuselage's arc.

Burt plans for pressurized coast to coast range in the 300 mph category. Passenger comfort is important as his design allows one to sleep and/or watch VCR TV on the flight. Plenty of elbow room will be provided to enhance comfort.

He has purchased O-360 Lycomings for temporary power but is expecting the Zoche Aero Diesel engine to be used eventually. His cowling and fuselage has a round cross section to accommodate the diesel design and provide minimum drag.

As I left Oshkosh for home, I saw fellows carrying two spruce boards that looked like spar material. I overheard one say to the other, "Just think, the next time this wood comes to Oshkosh it will be an airplane!"

Yes, Oshkosh is for dreamers -- **achieving dreamers!**

MDA and Homebuilders

Carl Stevens (CA) - Editor note: Carl, Long-EZ builder, is the editor of Chapter 49 newsletter and contributed this article to the CSA newsletter. I have edited this article to save space.

MDA AND HOMEBUILDERS

We, as home builders, are exposed to MDA in some of the epoxies and resin that we use. I am using Hexcel Saf-T-Poxy and Hexcel 4 minute epoxy, both of which contain MDA. So what is MDA and why should I be concerned?

Much of the following is from a paper written by Ed Fazio (works in the environmental safety and health department for Lockheed California), titled MDA in the Aerospace Workplace. If any of you would like to read his complete paper you may contact me for a copy. Please send an SASE with your request.

MDA is readily soluble in a variety of organic solvents and is easily absorbed through the skin (dermal absorption). It has a slightly ammonia-like smell. Ambient temperature and pressure conditions present an insignificant opportunity for vapor inhalation. MDA has been shown to have an oral toxicity in rats and is categorized as moderately toxic.

Routes of exposure for MDA include ingestion, eye contact, inhalation of particles and dermal absorption. The last is the most significant potential route of exposure when working with lay ups and coatings in your hanger or garage.

Acute body effects from MDA exposure include liver poisoning (hepatoxicicity), and eye damage. One study reported that a single dose of 10 mg/kg caused liver damage.

In reviewing this data the OSHA committee concluded that "it appears that carcinogenicity is induced either through ingestion, inhalation, or dermal absorption of the sub-