Canoe Material Evaluation

This discussion of the various materials used to construct the canoes available today is necessarily condensed to fit space limitations. It is intended however, to give you a basic insight into the differences between the several materials and their respective construction methods. Should more detailed information be required, we would be glad to recommend appropriate sources.

Basically how a canoe performs depends upon its design and the materials from which it has been constructed. Of course paddler skill and load weight also contribute to performance. Usually discussions about various canoes are dominated by materials considerations when actually design is of as much importance. Too often canoeists are preoccupied with material durability and neglect to consider the superior performance offered by the better designs. Certain materials, however, do not allow sophisticated designs due to construction limitations.

WOOD — Bark was one of the original materials used for construction of canoes by North American woodland Indians. Most generally paper birch placed inside out over white cedar ribs. The bark pieces, gunwales, stems and thwarts are then laced together with split roots. Currently bark canoes are available from only a handful of builders practicing this historic craft.

The balance of the wooden craft currently available are either wood strip or rib and plank. Wood strip canoes have no ribs and both the interior and exterior of the hull are covered with fiberglass cloth.

Rib and plank canoes have inner ribs supporting exterior planking which is covered with either treated canvas or fiberglass cloth. Lapstrake is a modified rib and plank where the planks overlap and are fastened at the edges. Any the methods of wood construction require great amounts of hand labor, therefore the cost is often high. On the other hand there are few design limitations with wood and the resulting hull can be quite stiff, naturally buoyant, light in weight and aesthetically beautiful. In fact, most canoe molds used with other materials started with a wooden canoe plug.

ALUMINUM — Grumman first introduced the aluminum canoe after World War II and the material soon dominated the canoe scene. Quality aluminum canoes are constructed of marine aluminum alloy stretch-formed over molds in a hull half. The halves are then heat-treated, age-hardened and subsequently riveted together to form the canoe. Quality of riveting and trim details are usually indicative of the overall quality of these canoes.

Some manufacturers use a weaker alloy which cannot be heat treated. Aluminum is stronger than steel by weight so a good aluminum canoe is going to be tough, maintenance free and relatively inexpensive. The drawbacks have been design and aesthetics.

FIBERGLASS — The word refers to a plastic resin reinforced with glass fibers. There are many ways to build a fiberglass canoe, but all start inside a mold. The most expensive is to lay in all layers of woven fabric by hand and carefully squeegee out all excess resin. Since the strength of a fiberglass canoe is in the glass fibers which are impregnated and held together by the plastic resin, the strongest canoes have a very high glass to resin ratio. Canoes resulting from this hand lay-up process are very strong and quite light. They can be identified by the pattern of the fabric weave which will be visible. The colored exteriors are simply a gel coat sprayed into the mold before actual lay-up begins.

At the other extreme, fiberglass canoes can be built using a 'chopper gun' and spraying a resin/glass-fiber mixture into the mold. The result of this process is a heavy, brittle, inexpensive canoe.

Only a very few top quality manufacturers use the all-fabric hand lay-up system. The rest use a combination of fabric and mat or in some instances, an all chopper gun system. Since a fiberglass laminate can be formed in almost any mold shape, there is more design freedom with fiberglass than with any other material except wood**.**

KEVLAR —An aramid (aromatic polyamide) fiber initially developed by DuPont for the aerospace industry for use where high strength and light weight are critical. It is an organic fiber which pound for pound is five times stronger than steel and which may be the ultimate canoe construction material.

Kevlar fabrics are used in the same way as fiberglass fabrics but they are lighter and have much greater toughness. Kevlar can be used in conjunction with fiberglass in most hull laminates because their properties complement one another. Combining the two offers the tensile strength, toughness, and light weight of Kevlar with the compressive strength and rigidity of fiberglass. For the appreciative paddler the better handling characteristics and lighter weight of a Kevlar or Kevlar/Hybrid canoe are well worth the extra cost.

CARBON — Graphite or carbon-fiber is a space age material that is stiffer and lighter than fiberglass but has virtually no toughness. That means that it can be used to construct a rigid product but when that product fails it does so suddenly and catastrophically, like a light bulb.

Kevlar, on the other hand, has high toughness, meaning that it can be bashed around quite a bit, becoming slowly weaker but not failing completely. Therefore the best use of Carbon in a canoe hull is as a hybrid with Kevlar to increase stiffness and decrease weight. It can be used to construct an ultra-light canoe hull, but this option should be selected only where lightest weight is critical and high resistance to abrasion and impact are not required.

ROYALEX — A laminated sandwich of layers of ABS (acrylonitrile-butadiene-styrene) structural plastic on either side of a foam core and protected by colored skins of cross-linked vinyl. Developed by Uniroyal and trademarked Royalex, the material has been used in canoe construction since the early 1960's. However, not all Royalex is alike! Each canoe manufacturer can specify his individual sheet layup for however he envisions his canoes used.

The Royalex sheet, looking much like a sheet of plywood as delivered from the manufacturer, is heated in an oven and then formed either in or over a mold into the desired canoe shape. The resulting canoe hull can be tough, durable, buoyant and maintenance free. It will however be quite flexible, a characteristic that allows it to escape damage upon impact but which does not contribute to the best paddeability. Because of the insulating properties of Royalex, it is quiet and does not transmit extremes of heat or cold.

POLYETHYLENE — A relatively recent development in canoe construction is the use of polyethylene. To date two separate processes are used to produce a polyethylene boat; both involve first heating and liquefying the polyethylene pellets.

Linear polyethylene is then extruded into sheet form and subsequently vacuum molded into the desired hull shape. Cross-linked polyethylene hulls are rotationally molded by spinning a mold on its axis so that the liquid is evenly dispersed throughout the mold. Sometimes the mold spin is stopped and started again to give differing layers of plastic.

Since the molds and equipment required is quite expensive, only conventional, volume selling hull designs are produced using this material. The drawbacks to polyethylene canoes are excessive flexibility, higher weight and ultraviolet deterioration. Advantages are good impact resistance and low cost.