

Title: **KEBONY METHOD OF WOOD MODIFICATION**

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Summary

The paper describes the development of furfurylated wood from invention to full-scale production and product sales. The whole process occurred over a period of about 60 years but the main thrust for commercialization was in the later part of this period, taking about 20 years.

1. Introduction

The author's career in wood protection began when creosote was the principle preservative. Then CCA became the main preservative used. Copper-based preservatives have largely replaced CCA. Recently, alternative wood protection methods have become practica. The author has been privileged to participate in the development and commercialization of one of these, Kebony wood.

In the Kebony process, sometimes called “furfurylation,” solid wood is impregnated with a liquid mixture of furfuryl alcohol, water and a polymerization catalyst. Standard wood preservation conditions are used for the impregnation. After impregnation is complete, the fluid mixture is contained in wood cell lumens and cell walls. In a subsequent heating process, the liquid mixture is polymerized to a solid. The cell walls are thus reinforced with polymer and the cell cavities also contain some polymer. Wood so treated is therefore chemically modified.

This chemically modified wood is stiffer, stronger, has a lower equilibrium moisture content and shrinks and swells less than unmodified wood. Agents of biodeterioration (decay fungi, insects and marine borers) do not apparently recognize it as wood, so, even though it is not toxic to them, they do not attack it. Since the treatment is polymerized, there is nothing to leached out. Its combustion products are similar to those of wood. So furfurylated wood is environmentally friendly.

Furfuryl alcohol is made from plant biomass, a renewable resource.

2. & 3. Methodology and Results and Discussion: History and development of Kebony wood

Furfurylated wood, although it was not called that then, was first developed in the 1950's in the USA. Chemical formulations and processes for making it commercial were developed in Canada and Sweden in the 1980s and 90s. These developments were combined to become the commercial product that today is known as Kebony wood.

When the Canadian polymer modified wood technology was first introduced to Norway, it included treatments using styrene and others using furfuryl alcohol. Scaling up the styrene treatments from the lab scale were what the predecessor company to Kebony ASA was first engaged in. To do so, a small treating plant was built in Hoylandet, northern Norway (near Trondheim). The company stimulated interest in the technology in Europe and the USA. The company sublicensed production of dark-colored, furfurylated flooring material to Boen Bruk AS in Norway for commercial production. That flooring remains in production.

In 2001 the company selected Kebony for all its products and for its company name. Through popular usage, “Kebony” has also become the name of the treating process and the name of the product. The company has focussed its developments on Kebony softwood as a non-toxic alternative to pressure treated conifer wood and, using temperate zone hardwoods, as a replacement for tropical hardwoods.

The Kebony ASA web page (www.Kebony.com) history section includes the following:

“From 1997 to 2001, Kebony was mainly financed through family and friends of the founders. In 2001, the company raised capital through professional investors that allowed Kebony to step up its

research activities. The planning of a pilot production facility was initiated early 2003 and the plant officially opened in August the same year.”

The plant was located in Spydeberg, Norway. It was pilot-scale industrial production facility, using mainly styrene. In the 2 years it operated, 1700 railway ties, poles, stakes and lumber for outdoor use were produced. The ties were placed in test tracks in Europe and the USA.

The web site continues, “In the spring of 2003, WPT received its first international recognition for its technologies. At a research conference in Gent, Belgium, several independent researchers presented test results for alternative wood modification technologies. One of the main conclusions from the conference was that Kebony’s technology was the only technology that both significantly enhanced the properties of wood and had an apparent potential for commercialization.

In April 2007, Wood AS, a company owned by leading Norwegian industrialists, became the leading shareholder and took control of the further development of Kebony ASA. The new owners chose to focus more on internationalization and the opportunity to replace tropical woods to accelerate growth. Wood AS also initiated the planning of a new full scale factory which opened in January 2009. The facility is state of the art, capable of producing any product combination and capture vital quality data that forms important building blocks in the license program. In 2010 the London-based investment funds, Environmental Technologies Funds and Naxos Investment Partners invested €12 million to support Kebony in its international expansion.”

Kebony has been active promoting furfurylated wood at conferences and through the media. There has been a comprehensive test program. Samples have been tested in accredited European and US labs for decay resistance, vapor emissions, emissions during combustion, ecotoxicity, termite and marine borer resistance and mechanical properties. Accreditation in the USA has been pursued.

Throughout this process of developing the technology, there has been time after time when seemingly insurmountable obstacles have occurred. Each time, an idea or the right person would appear and help us to break through the obstacle and continue. As a Christian, the author is grateful for the help and leading that has occurred which he believes comes from God.

4. Conclusions: Commercial status of Kebony wood

Furfurylated conifer wood has been sold and used in Norway for decking, siding, wharves and various municipal and private installations for several years. There are example photographs in the Kebony web site.

In the USA, there have been many projects utilizing Kebony wood. Two of the largest are the Bethany Beach, Delaware, boardwalk, which has been installed for two seasons, and the Lenz Tennis courts at Princeton University. Bethany will install the final batch of product this winter.

Kebony USA has recently installed 100 boards in a test site on the Manhattan Side of the Brooklyn Bridge and this stimulated interest from the crew on the Bronx side. Another project starting soon in New York City is bench slats from maple and southern pine at Hunters Point, South. Kebony is also negotiating a big project at the Dallas Arboretum Children's Garden. Three product distributors will be ordering container lots in the USA soon. A US production plant is expected to be operating in about 2 years.

In Canada, the first Kebony wood installation is planned for the inventor's new home this fall. This pending installation has stimulated interest from architects and home builders in Canada.