WoTIM

Newsletter #2 | December 2014

www.wotim.eu

Dear reader,

Newsletters from the WoTIM project are being published twice a year to keep you updated with the progress in the Work Packages (WP). In this second newsletter we present some results from WP 2 about lignocellulosic fibre sources and processing methods and from WP 3 about foam forming of semi-rigid 100% natural fibre based thermal insulation panels.

The fact that there is an interest in new wood-based isolation materials was proved to me recently. During the 9th Global Insulation Conference in Copenhagen on 30-31 October, I gave a presentation with the title "Foam-laid formed wood-based thermal insulation materials". The reception was positive and many insulation company showed an interest.

In spring 2015, FCBA will organize a training module in Grenoble on Wood fibres and their suitability for thermal insulation materials. More detailed information will be published in web site www.wotim.eu.

Petri Jetsu, VTT
Project Coordinator

Lignocellulosic fibre sources and processing methods

Wood and annual plant fibres are basically constituted of cellulose, lignin and hemicellulose. Pectin, waxes, pigments and extractives can be found in lower quantities. Cellulose, an important component of all natural fibres, is the most abundant natural polymer available on the earth. Cellulose is found in wood, plants and bacteria, in different sizes and quantities. Globally, the most important cellulose fibre sources are hardwood and softwood trees. Sources of different cellulose containing natural fibres are illustrated in Figure 1.

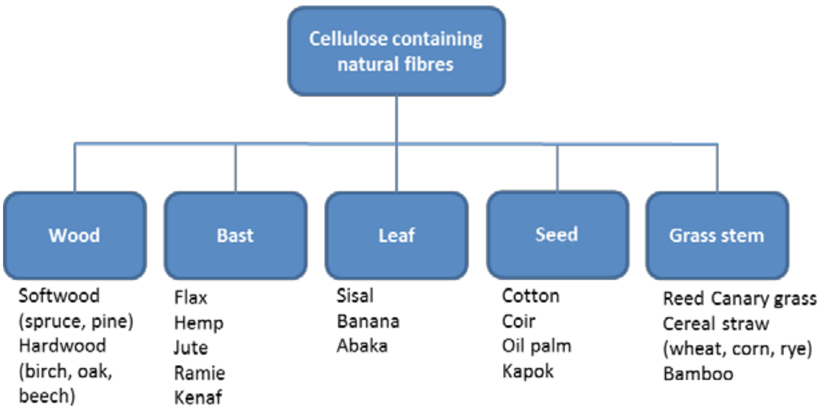

Figure 1. Different sources of natural lignocellulosic fibres.

Pulping can mainly be done in two ways, either mechanically or chemically. The main principle behind mechanical pulping is to break down the structure to fibres and fines by subjecting the wood raw material to mechanical forces. There are two major methods of producing mechanical pulp; by pressing wood logs against a revolving pulpstone (grinding), and by disintegrating wood chips in a disc refiner (refining). Chemical pulps are produced by cooking pre-cut wood chips in a pressure vessel in the presence of

1) bisulphite liquor -> sulphite pulp
2) hydroxide (soda) liquor -> sulphate or Kraft pulp

Cooking removes lignin and separates the wood into cellulose fibres. Chemical pulp fibres are more flexible than mechanical pulp fibres leading to more dense structures. They are also stronger and they form stronger sheets, because lignin or extractives do not limit bonding.

Nanocelluloses provide a new materials platform for the sustainable production of high-performance products in an array of applications. Nanocellulose is simply wood fibre broken down to the nanoscale, at least one dimension being in the nanometer range. There are basically two families of nano-sized cellulosic material. The first one consists of cellulose nanofibrils (CNF or nanofibrillated cellulose, NFC) and the second one cellulose nanocrystals (CNC).

Nanofibrillated cellulose, also called microfibrillated cellulose (MFC) is obtained when cellulose fibers are submitted to high mechanical shearing forces. NFC is generally produced by delamination of wood fibers through mechanical pressure before and/or after chemical or enzymatic treatment. Contrary to long and flexible cellulose nano/microfibrils, cellulose nanocrystals (CNC) are straight rod-like cellulose particles. CNCs can be obtained via acid hydrolysis.

Foam forming of semi-rigid 100% natural fibre based thermal insulation panels

Foam forming technology adapted from other industries is used for manufacturing high performance 100% cellulosic thermal insulation panels. Foam forming is a wet forming technique allowing the cellulose fibres to form hydrogen bonds, meaning that no additional synthetic binders are needed. The technology enables a wide raw material base from coarse centimetre-sized particles to nano materials and offers suitable porous material structure for insulation purposes. The technology allows the development of products that can consist of different layers integrated into one product. The product may, for example have air barrier properties with suitable vapour tightness of the internal and external layers. Also the thermal conductivity and structural strength properties can be adjusted suitable for the application.

First foam forming trials have been made with the objective to evaluate the effects of different (ligno) cellulosic raw materials on thermal insulation and mechanical properties of the thick (>1 cm) foam formed insulation panels. Bleached softwood and hardwood kraft and thermomechanical (TMP) pulps were used in the trials. Microfibrillated cellulose was used as dry strength additive. The densities of the panels manufactured varied between 23-80 kg/m³.

The lowest thermal conductivity measured at this point has been 0.037 W/m•K with 100% unrefined softwood kraft pulp at density level 32 kg/m³. The TMP containing panels had the highest rigidity and compression strength. All foam formed panels could be classified as semi-rigid insulation materials that could be used between rafters in roofs or in walls of wood constructions as well as in internal partition walls. The development work continues with the addition of fire and fungus resistance as well as investigating pore structure controlling and material layering as tools to further improve thermal insulation properties.

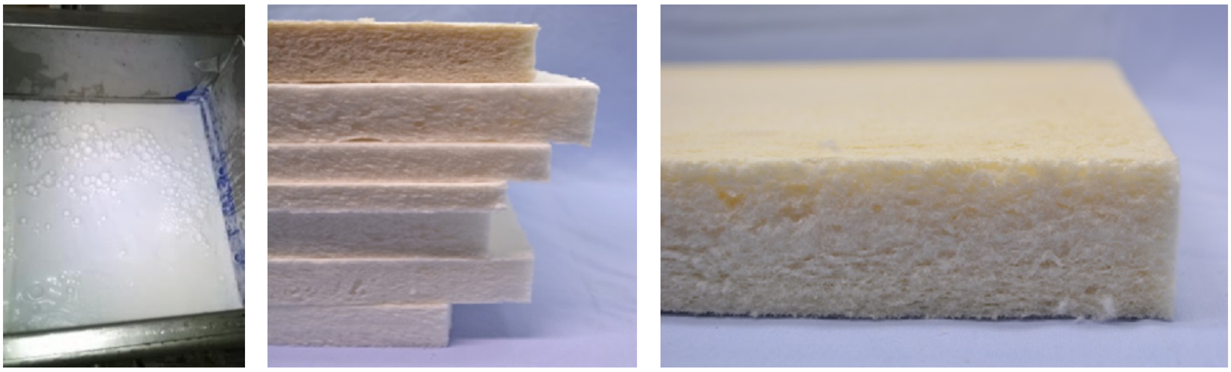

Figure 1. From left: foam forming mould full of wet fibre foam, semi-rigid foam formed thermal insulation panels made of various papermaking pulps, largening of the structure of a foam-formed materials made of 50% softwood kraft and 50% TMP pulp.