Hajnalka Hargitai: „Reinforcing of polypropylene with hydrophil fibers”
Ph.D. Thesis

NEW SCIENTIFIC RESULTS

The new scientific results (1-4) of the PhD Thesis are as follows:

1. An increase in the **moisture content** of flax fibers had a **negative effect** on most important mechanical properties of short fiber reinforced polypropylene composites when no additive was used.
   The tensile modulus decreased dramatically, it was found to be about three times higher (2.8) for samples containing fibers with the lowest investigated moisture content (3,99 %, RH=11.3 %) than for specimens containing flax conditioned on the highest relative humidity (97.3%) investigated. Similar tendencies were shown by the Izod impact strength, but the decrease was smaller, a difference of 25% was found between the impact characters of composite samples going from the wettest to the driest.

2. The **water uptake** curves of short flax fiber reinforced polypropylene composites were found to be satisfactorily described by a **Fick-type** equation, a linear correlation existed between water uptake and the square root of time.
   An **influence of the original moisture** content of fibers was pointed out **on the K parameter –** calculated from the equation based on the Fick's II. law **-**, being the rate of water uptake, when no additive or only a small amount of maleic anhydride grafted polypropylene (PPgMA) was added. In these compositions lower water uptake rate parameters (K) were found at higher original moisture contents.

3. The positive effect of the compatibilizing agent PPgMA was pointed out on the static mechanical properties of flax fiber reinforced polypropylene composites, while the notched Izod-type impact strength decreased. By increasing the additive content, the rate of water uptake decreased also, and at higher PPgMA content the differences levelled off.
   However **compatibilizing efficiency** of the additive was found to be **influenced by the original moisture content** of fibers, indicated by the poor mechanical properties, PPgMA seemed to be less effective by using "wet" fibers than in case of composites from "dry" fibers.
   It is assumed that some of the anhydride groups do not react with cellulose, but with the OH-groups of the water, and thus interfacial adhesion is weaker between the components of composites from wetted fibers.

4.a **Radiation treatment** of hemp/viscose fibers was not effective, while using on **glass fibers** (30 wt%) was found to be very **effective** in recycled polypropylene based composites.
   Applying 10 kGy electron beam on glass fibers before melt mixing, two times higher flexural modulus of composite could be achieved related to that of an uncompatibilized system.

4.b The chemical composition of the surfaces of fibers extracted from the composites was analysed by the **ESCA** method (Electron Spectroscopy for Chemical Analysis). A **correlation** was observed between the sum of contaminating trace elements detected on the surface of PAN fibers and the flexural modulus of PAN fiber reinforced composites.
   The ESCA method has the potential to be used for characterizing the adhesion between the components of the composite material, and offers a comparative method for investigating the efficiency of different treatments on reinforcing fibers.