The synthetic crude oil based polymeric materials are today seen as harmful for the environment, which has been seen especially in the Pacific Ocean. Littering, pollution and a slow biodegradation have resulted in the formation of huge floating "plastic waste islands", which are threatening the marine ecosystem through release of stabilizers and other additives. Therefore it is necessary to develop plastic materials from biobased resources, which also can degrade safely in the ecosystem, without formation of harmful substances. For packaging biobased and biodegrading plastics are especially interesting, as packaging films are disposed and easily littered in the nature. [1] Proteins are polymers, which play a vital role as structures or as biologically active components in living organisms, and proteins can also be extracted from the biomass and used as polymeric materials. [2]

Casein is a protein polymer, which has been used historically in plastic applications, and casein was selected as the matrix polymer in this study. In order to improve the mechanical strength, we have used man-made cellulosic fibres as reinforcement. These fibres were selected due to their good properties, purity, well defined fibre diameter as well as good availability in large.

The casein biofilms were fabricated by solution casting from an aqueous alkaline solution of the bovine milk protein casein in the presence of glycerol as a plasticizer. The fibre-reinforced biocomposites were prepared by the addition of regenerated cellulose fibre (Lyocell) to the casein solution with various amounts of glycerol. The effects of glycerol content and Lyocell fibre reinforcements on the mechanical, thermal and physiological properties were characterized.

The results exhibited that increasing glycerol content decreased the film strength, Young’s modulus and thermal stability with a gradual increase in the elongation. However, the tensile properties were noticeably improved when reinforced with Lyocell fibre. The composite with 20 wt-% glycerol and 20 wt-% Lyocell showed the maximum tensile strength of 23.5 MPa and Young’s modulus of 1.5 GPa. The corresponding values for the composite with 30 wt-% glycerol and same fibre content were 15.1 MPa and 0.9 GPa, which were 2.3-fold and 3.2-fold higher compared to 30 wt-% glycerol plasticized film.

By electrophoresis (SDS-PAGE) it was seen that there was no significant change in the molecular weight of the casein protein during sample preparation. Scanning electron microscopy analysis showed further that the obtained composites with low glycerol content had adequate interfacial bonding, and the intermolecular networks were formed in the casein films when assessed using FT-IR.

References