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New Generation of Pocket Spring Units

Target

The aim of this research project was to develop a new type of spunbond material based on polylactide (PLA) and other biopolymers for the use as pocket spring units in sleeping systems (mattresses and upholstery). Material development based on renewable raw materials was supposed to be technologically designed to particularly meet the criteria of even better environmentally friendly disposal, e.g. by composting and not only by thermal recycling, and thus match the 100% recycling idea. Finally, investigations were carried out on the recycling and environmentally sound disposal of PLA biopolymer components. The tests on outdoor weathering exposure (EN ISO 105-B03:2018-03) as well as hydrolysis (A4 EN 12447) and microbiological resistance (A4 EN 12225) of biogenic spunbond materials showed positive results.

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Solution

The PLA product samples were supposed to have both, significantly increased tensile strength and surface abrasion resistance compared to existing PLA nonwoven materials. The aim was to use Martindale to resist 5000 tours at 9kPa according to EN ISO 12947-2 and to pass durability by means of rolling test on pocket spring load test stand based on EN 1957:2013, RAL-GZ 430/2. These values should be achieved by the use of improved higher melting PLA polymers and by using additives in bicomponent technology as well as water jet technology during inline processing.

Results

For the product development bicomponent spunbond nonwovens made from PLA and other biopolymers with different filament fineness were produced with regard to high mechanical strength, especially using surface weights between 60 – 80 gsm according to specifications of the Industrial partner. Depending on these parameters, the web laydown was optimized by targeting fine adjustments for extrusion, spinning conditions and filament drawing in the cabin and diffuser system.

In order to determine optimum conditions for thermal bonding, pressure and temperature were adjusted on the calander to respective material throughput and conveyor belt speed. These adjustments are particularly challenging during processing of PLA and other biopolymers, as these materials, unlike polyolefins or conventional polyester, have no particular melt sticking affinity. PBS (polybutylene succinate) and/or Bio-PE (polyethylene) were blended both into the core and sheath of bicomponent PLA filaments to overcome this unfavorable characteristic in the bicomponent spinning process and to improve thermal bonding.

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Hydroentangled PLA/biopolymer nonwovens were also produced in terms of mechanical properties such as tensile strength, tear growth resistance or surface abrasion resistance. The water pressure of individual water beams was adjusted and fine-tuned to enhance nonwoven properties. Thus, especially with regard to mechanical strength, significant improvements were achieved compared to thermal bonding.

At the end of the research project, it can be noted that PLA with PBS or Bio-PE are well suited as possible biogenic raw materials for the spunbond process as well as pocket spring units. Both, the spunbond nonwoven production by thermal bonding (calander) and by mechanical bonding (hydroentanglement) can be implemented. Thermal bonding shows advantages in surface abrasion resistance, mechanical bonding shows improvements in structural tensile strength. With the help of blending PBS or Bio-PE into PLA, the brittleness of this material could be reduced, spinning stability increased, web shrinkage reduced and surface weldability significantly improved.

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