Fabrication of Ethylene Vinyl Acetate and Wood Flour Waste Composites: Study of Physical and Mechanical Properties

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Introduction

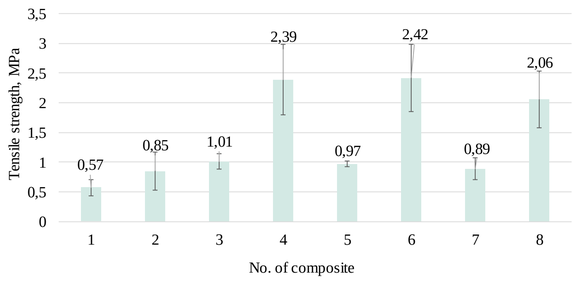
Nowadays efficient municipal as well as industrial waste management is considered as one of the most relevant ecological issues. Reusing and recycling of industrial waste is a way not only to reduce negative impact on the environment by minimizing the amount of waste disposed in landfills, but also diminish the cost of raw materials and contribute to the development of a circular economy. One of the industrial activities that generates a relatively large amount of ethylene-vinyl acetate (EVA) and wood waste, is the production of footwear. Unlike wood, recycling of EVA waste is more complicated and requires more expenditures. As a result, current EVA waste management strategies are mainly based on landfills, but not on material recovery. Due to the high calorific value and the relatively low required costs, a big part of wood waste is incinerated (energy recovery). However, in line with the ideas set out in the EU Circular Economy Action Plan, all waste management should be addressed in a way that keeps the raw material in its life cycle for as long as possible. The aim of current study is the use of EVA crumbs and beechwood flour to fabricate polymer composites.

Fabricated composites

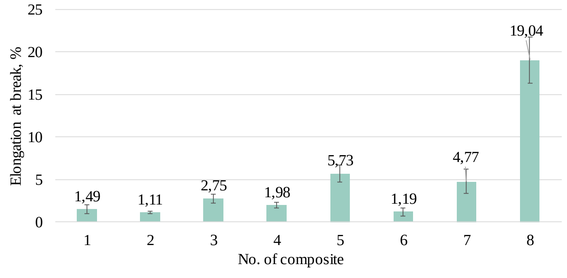
No.	The weight ratio of EVA crumbs to wood flour and PA binder, g	Hardness, Shore A	Density, g/cm^3
1.	40/60/0	91	0.67
2.	40/60/20	95	0.78
3.	60/40/0	91	0.69
4.	60/40/20	94	0.89
5.	80/0/20	87	0.71
6.	0/80/20	95	0.71
7.	80/20/0	90	0.73
8.	100/0/0	91	0.80

Results

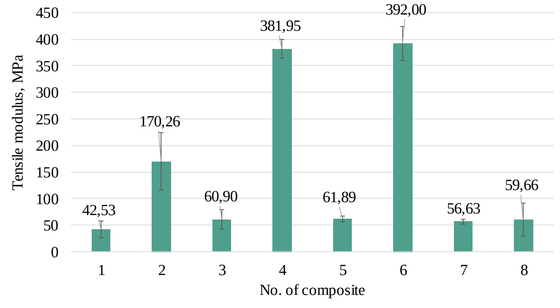
Generally, the tensile strength of the composites increases with the addition of PA regardless of the sample type. Presented data show that composites No. 6, consisting only beechwood and PA binder (80/20), has the highest tensile strength while composite No. 1, made of EVA, beechwood and PA (60/40/20) has the lowest.



Composite No. 8, consisting only EVA, stands out by the 19,07 % value of elongation at break. The second highest value is attributed to the sample of EVA crumbs with PA (80/20). In contrast, composites No. 2 and No. 6, which consist of the largest amount of wood waste, have the lowest elongation at break values.



The highest tensile modulus is attributed to sample No. 6, consisting of beechwood and PA (80/20) while composite No. 4, made from EVA, beechwood and PA (60/40/20), has the second highest value.



Methods of research

Tensile testing was performed according to the LST EN 12568:2010 standard. Evaluation of properties was performed on universal testing machine “Tinius Olsen H25KT” (England) at a constant displacement rate of 20 mm/min and load cell capacity of 5 kN.

50 × 50 mm specimens were cut from the produced sheet in order to evaluate density of the composites. Samples were weighed with Kern EW 4200-2NM scales (accuracy – 0,001 g).

Hardness measurements of composites were performed according to ISO 7619-1 requirements by using HPSA-M Shore A durometer (Germany). Six measurements were taken in order to obtain each experimental point.

Conclusions

- During this research EVA/beechwood composites with PA binder were successfully formulated and their mechanical and physical properties were investigated.
- It was observed that in most cases, the amount of wood waste in the composite is inversely proportional to its value of the elongation at break.
- The addition of PA binder into the composition determinates the increase of composites’ hardness by ~4 % and density by 23 %.
- The obtained results create the conditions to produce new composites from industrial wood and EVA foam waste and reduce environmental pollution.