Microplastic Formation During Weathering of Wood Plastic Composites and the Effect of Additives

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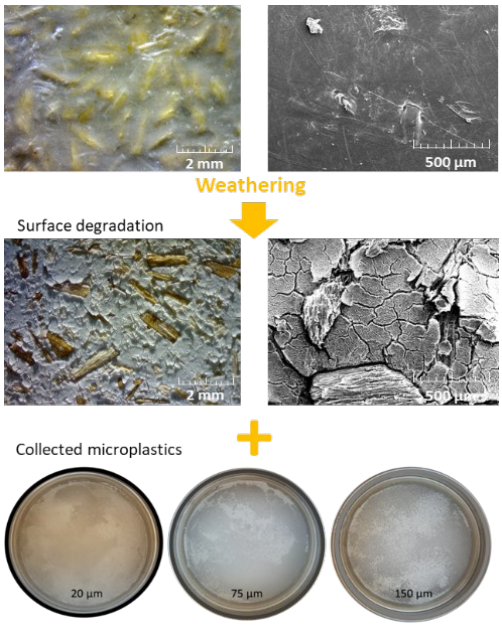

Figure 1: Weathering of wood plastic composite (without additives) and resulting surface degradation with microplastic release collected on sieves.

Wood plastic composites are widely used in construction, automotive, furniture, and consumer products, particularly in North America and Asia. They are also becoming increasingly popular in Europe. The market for WPCs is expected to continue to grow in the coming years, driven by their sustainability, durability, and versatility [1]. However, one important sustainability aspect of these materials has not been studied: microplastics (MPs). The tiny plastic pieces have been recognized as a serious threat by various organisations, and WPCs can be a potential source considering that they are mainly used in outdoor applications where UV radiation can cause sevear degradation [2]. The presented study uses a unique process design specifically developed to quantify the mass of MPs formed during artificial weathering of plastic-based materials. The process is based on a QUV accelerated weathering tester, which was accordingly modified to enable collection of MPs. All WPCs used in the study consisted of recycled polypropylene and wood particles (60:40 by mass). To evaluate if and to what extent additives can affect the release of MPs, five types of additives (coupling agent, antioxidant, pigment, UV absorber and UV stabilizer) were added according to the manufacturer's recommendations. The results showed that without additives, the WPCs released 4.4 g/m^2 of MPs (> 20 µm) during 1 month of artificial weathering. This was due to the surface erosion caused by photodegradation of the plastic matrix, as indicated by both the exposed wood particles and the collected MPs (Figure 1). The formation of MPs was significantly reduced/delayed by the used additives. UV absorber and UV stabilizer were the most effective reducing the amount of MPs by around 80 %. Other additives also had an effect. The improvement was also clearly visible on the surface of the WPCs showing less signs of degradation when analysed by SEM, FTIR and contact angle goniometer. The study reveals that MPs can be released from WPCs, but this process higly depends on the composition.

Keywords: microplastics, wood plastic composites, polypropylene, additives, weathering, degradation, surface erosion, protection.

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References

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