END OF LIFE TRETMENT OF POLYMER COMPOSITE MATERIALS

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Abstract

Because of increasing environmental demands, especially on dealing with products end of life phase, product manufacturers and designers must consider the future disposal of their products. For conventional materials like steel and aluminium well-functioning recycling methods exists. This is not the case for structures of polymer composites, which are used more extensively, especially for structures like vehicles and vessels. Several techniques do exist but they are not yet commercially available. The current disposal methods of polymer composites are landfill and incineration.

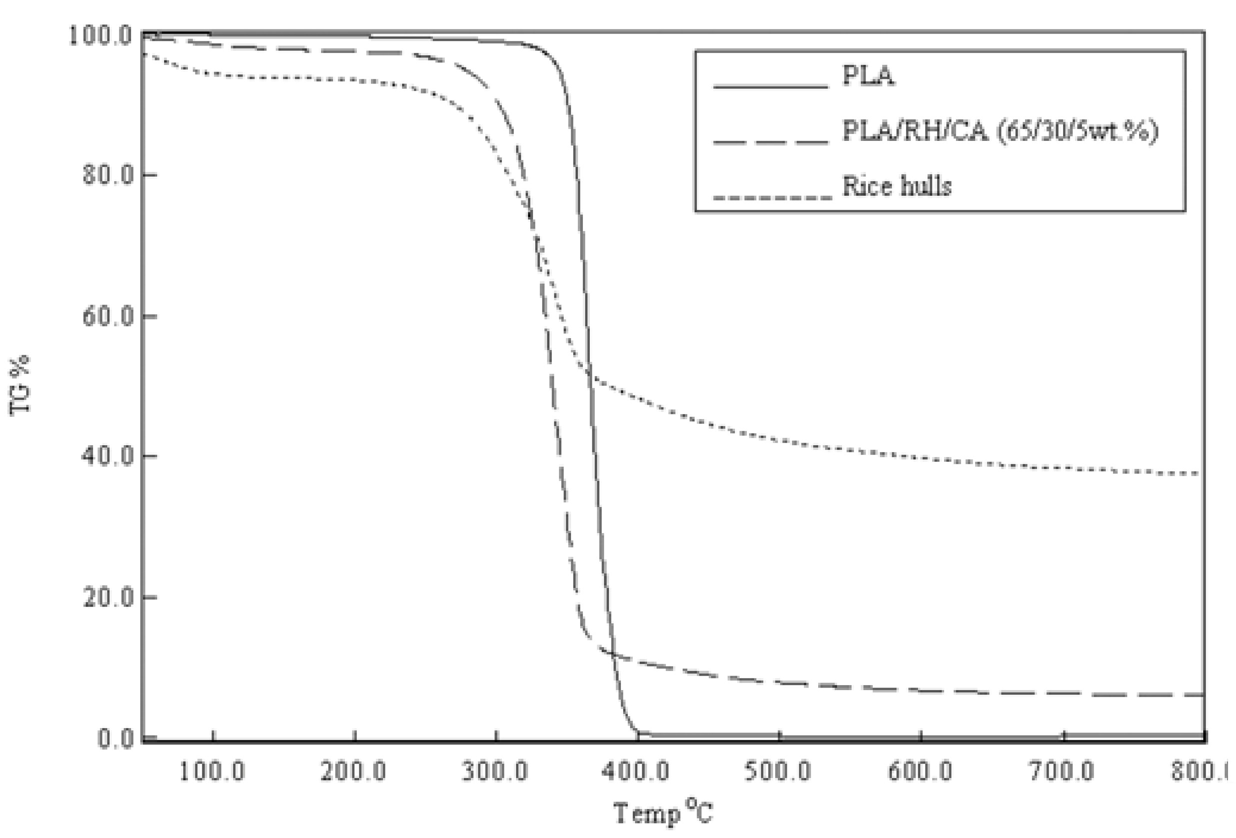
Polymer composites are materials, which consist of several materials like fibre, matrix, and additives. This circumstance complicates the waste treatment of composite materials. Therefore, it is necessary to develop adequate waste treatment techniques for polymer composites including sandwich structures. Recommendations for waste treatment have been formed for a number of polymer composites. These recommendations are based on the analysis of costs and environmental effects and they compare different scenarios for mechanical material recycling and energy recovery by waste incineration. Recycling of the polymer materials largely depends ~~from~~ on the type of ~~used~~ polymer matrix. Incineration is one of the methods for waste treatment of polymer composite materials, because it can be used for energy recovery. However, waste incineration will always result in a additional cost for the waste producer.

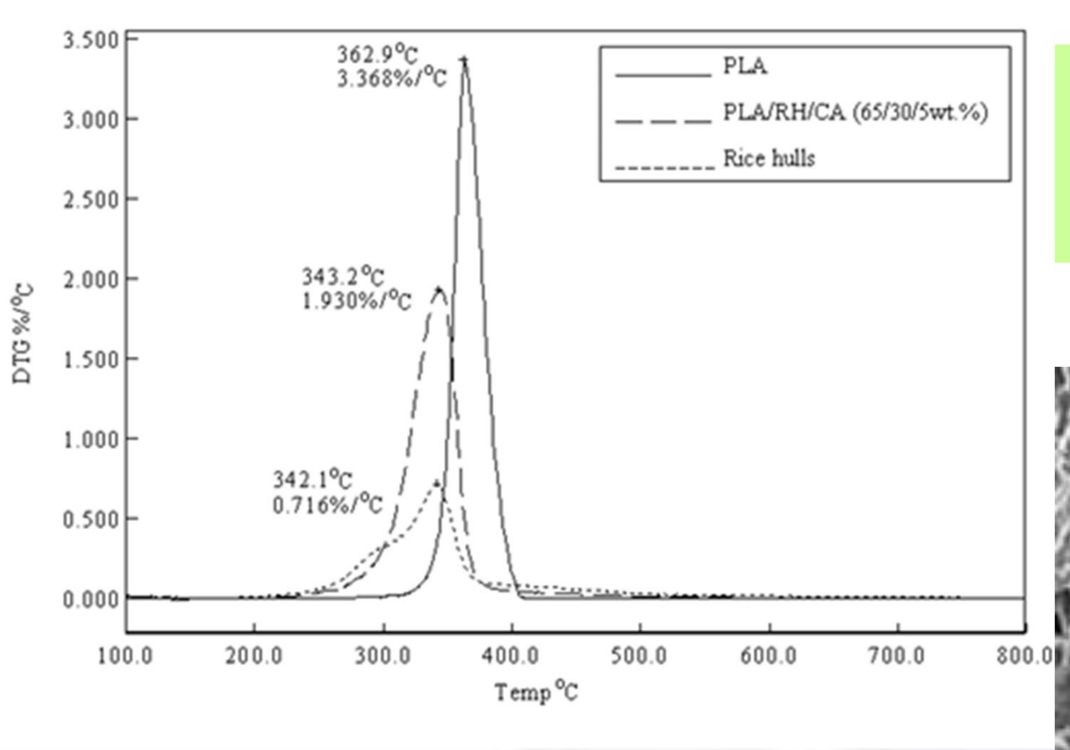
Many investigations have pointed out recycling of polymer composite materials as the best alternative considering environmental effects. Since recycling of polymer composites is a complicated process, especially recycling thermoset composite it is important to acquire comprehensive information about the constituents of these materials.

Flexural properties of neat and recycled PP and PLA matrices

Sample	Stress at peak, MPa	Standard deviation	Modulus, GPa	Standard deviation
PP neat	51,5	5,5	1,08	0,120
PP x1	52,8	2,1	1,31	0,064
PP x2	49,5	2,9	1,34	0,101
PLA neat	32,0	3,8	2,42	0,204
PLA x1	32,0	6,1	2,43	0,193

Thermogravimetric curves of PLA, rice hulls and PLA/RH biocomposites: weight loss (%) versus temperature





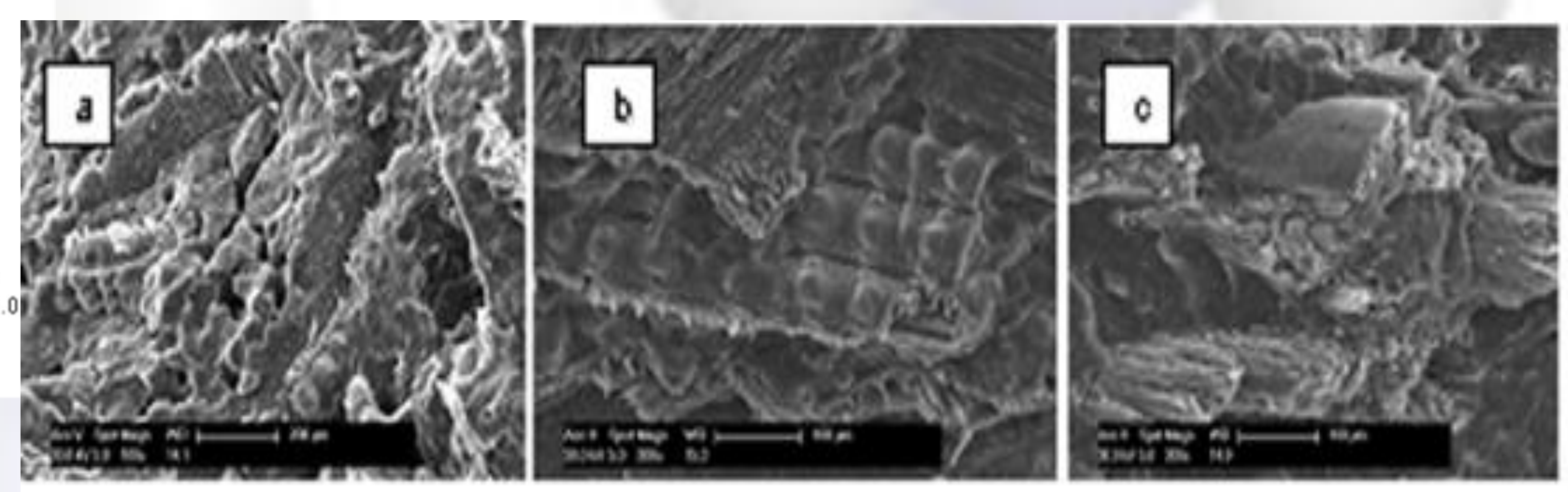
Sample	Td_{90} (°C)	Td_{50} (°C)	Td_{10} (°C)
PP neat	377,60	429,32	449,79
PP x1	357,49	414,67	438,64
PP x2	354,87	403,64	427,15
PLA neat	332,22	362,52	380,07
PLAx1	329,68	364, 21	382,98

Sample	Td_{90} (°C)	Td_{50} (°C)	Td_{10} (°C)
PP/RH	344,43	411,21	452,17
PPx1/RH	309,09	385,22	458,82
PPx2/RH	343,53	405,97	475,27
PLAx1/RH	299,42	341,70	529,70
PP/K	356,81	408,94	441,96
PPx1/K	356,92	412,35	443,77

Flexural properties of composites produced with neat and recycled matrices

Sample	Stress at peak, MPa	Modulus, GPa
PP / RH	42,6 ± 3,4	1,9 ± 0,08
PPx1 / RH	42,2 ± 1,2	1,8 ± 0,04
PPx2 / RH	39,6 ± 4,6	1,8 ± 0,06
PP / K	51,3 ± 4,8	2,1 ± 0,07
PPx1 / K	51,1 ± 4,0	2,3 ± 0,20
PLA / RH	28,8 ± 6,6	3,0 ± 0,18
PLAx1 / RH	14,8 ± 1,3	2,3 ± 0,46

SEM micrographs of cryogenically fractured surfaces of PP/kenaf composite samples: a) PP/K; b) PP/K (x1); c) PP/K (x2)



SEM micrographs of cryogenically fractured surfaces of PLA/RH composite samples: a) PLA (x1)/RH; b) PLA/RH (x1); c) PLA/RH (x2)