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Recycling of Waste Tyre Rubber Containing Natural Rubber with the Aid of Ionising Radiation

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The production of synthetic polymers is growing worldwide. They can be produced from both non-renewable and renewable resources. Polymers produced from renewable resources can be integrated into the circular economy. Natural rubber is an excellent example of a polymer produced from renewable resources. This material is used in large quantities to make tyres, although tyres also contain synthetic rubber. Tyres enter the waste stream after a few years, but the problem of their recycling is only partially solved, even though they are a valuable material, partly derived from renewable resources. A significant problem is the cross-linked structure of GTR, as it cannot dissolve in the matrix and forms a separate phase. The phases work well together if there is sufficient compatibility between them.

Many methods have been developed to increase compatibility, but these typically use hazardous chemicals and are not considered green solutions. Ionizing radiation, however, can provide an environmentally friendly way to increase compatibility. If irradiation of the GTR is carried out in a medium containing oxygen, there is a good chance that active groups will appear on the surface of the GTR, leading to more favourable compatibility conditions with the matrix materials. Based on these results, we used gamma radiation in an air atmosphere for surface activation of GTR. The surface-activated GTR was then mixed with natural rubber and vulcanized.

The results showed that surface activation was successful: the irradiation resulted in an increase in strength and a nearly constant elongation at break. The effectiveness of irradiation was confirmed by spectroscopic studies.