# AZ 2.4 RECOVERY OF HETEROGENEOUS PLASTICS FOR MODIFIED ASPHALTS

Plastic is a non-biodegradable material that remain in the environment for over 4500 years, contributing to environmental pollution with its dispersion and accumulation. Land, oceans, animals and man are potentially exposed to different sources of plastic waste contamination, making increasingly urgent an integrated approach to recovery and recycle these materials.[1] The linear setting of production according to the scheme "produce - disposable" is no longer possible for sustainability of the process and circular economy.

Circular Economy (CE) provides a restorative or regenerative industrial design system, which uses and reuses resources efficiently.[2] CE also promotes the introduction of sustainable design strategies, pollution prevention with new processes/products, zero waste, prolongation of the life of products and their reuse and possible recycling. CE is closely linked with the principles of 3R (reduce, reuse, recycle) that should be applied throughout the entire cycle of production, consumption and restitution of resources, involving the entire supply chain, from production to distribution, from use to recovery at the end of life.[3]

The latest statistics from Corepla, the National Consortium for the collection, recycling and recovery of plastic packaging, report that in 2018 more than 1,200,000 tons of plastic were separately collected (+13.6% compared to 2017). The average national figure of harvest per capita 2018 is 20 kg against 18 in 2017. The most virtuous regions of Italy are confirmed Veneto and Sardinia with just over 28 kg/inhabitant/year.[4]

The different plastics that are collected are initiated to different processes, as separation and washing, that allow the selective recovery of similar plastics to reuse these wastes for the production of new materials (SRM: secondary raw material). However, not all plastics that are recovered by separate collection are recycled. Today, the residual fraction has no commercial value but is actually disposed of for a fee by the collection centres.

This project concerns the possibility of recovering this end-of-life waste to further reduce the proportion of non-recycled plastic and to reduce disposal costs, the combustion of plastics and consequently the production of $CO_2$. One of the ideas that were considered for the disposal of plastic waste was the incorporation of this material in bituminous conglomerates for road construction. Preliminary studies have shown that the introduction of small percentages of plastics in asphalt, especially if they contain polyolefins, leads to an improvement in the mechanical properties of the road in terms of flexibility, stability, water resistance. The added polyolefins behave as chemical additives capable of extending the life of the asphalt. To date, the studies reported in literature concern the use of virgin polymers or recycled plastic (SRM).[5-10]

The main objective of the SARR project, AZ. 2.4 is the feasibility analysis of the application of end-of-life waste, consisting of heterogeneous plastics, as an additive to produce asphalt.

For this reason, recycled plastics or SRM, obtained from the processing of a first selection of plastic waste and already having a market, will not be taken into account.

On the contrary, the focus of the SARR project, AZ 2.4 is on end-of-life plastic (EOLP). The interest in this waste material is both economic and environmental because it is not reusable except for the production of electricity in waste to energy plants and has a disposal cost, which is between 70€-80€/ton.

The end-of-life plastic also contains other materials such as stones, textile threads, labels and metal pieces. A major problem due to the introduction of end-of-life plastics into the bituminous conglomerate is the possible physical heterogeneity. First tests were carried out to try to melt the EOLP samples: this would have allowed to obtain a greater homogeneity of the plastic mixture avoiding the need to grind the plastic material before adding to the bitumen. The grinding of plastic is a difficult process because the material requires a controlled grinding temperature to avoid that the plastic founds. For this purpose, it was necessary to assess whether the EOLP had a melting or softening point within a temperature range not exceeding 220-250°C. Unfortunately, the results obtained are not reproducible and in most cases at T< 250°C the softening rate is negligible. The need to introduce plastic in solid form to the desired size has therefore been confirmed.

Once these results had been established, actual tests were carried out to amalgamate the end-of-life plastic with the bituminous conglomerate. The addition of 4% of EOLP to the total bitumen allows to pack a final product well amalgamated having characteristics that meet the parameters provided by the CSA ANAS. The end-of-life plastic introduced acts as a chemical additive for the bituminous conglomerate making the product more rigid and, therefore, able to avoid the "footprint effect". The volume weight of the aggregate mixture with the addition of plastics decreases while the voids content increases. Marshall's stability improves as the value of ITS.

**References**


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