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# HETEROGENEOUS PLASTICS MIXTURE MODIFIED BITUMEN CHARACTERIZATION AND PROPERTIES

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The recycling of post-consumer plastics is a well assessed process only if homogeneous polymers are reprocessed. Indeed, only in this case the final properties of this secondary material are useful for several applications [1-3]. On the contrary, the recycling of heterogeneous polymers gives rise to secondary materials with low mechanical properties that can be used only for the production of items with big thickness [4-5]. A possible use of this heterogeneous plastics mix could be as a modifier agent in bitumen. Aim of this work is to investigate the use of the mixed plastics as modifier in bitumen, having regards to the conventional properties required for a bituminous binder for road application and during the mixtures production process in the asphalt hot mixing plant (stability, viscosity and mixing temperature, mainly).

## Materials

A sample of plastics waste mixture (Plasmix) has been received from COREPLA (the Italian Consortium for recovery and recycling of post-consumer packaging waste). The neat bitumen used in this research was a 50/70 penetration grade.

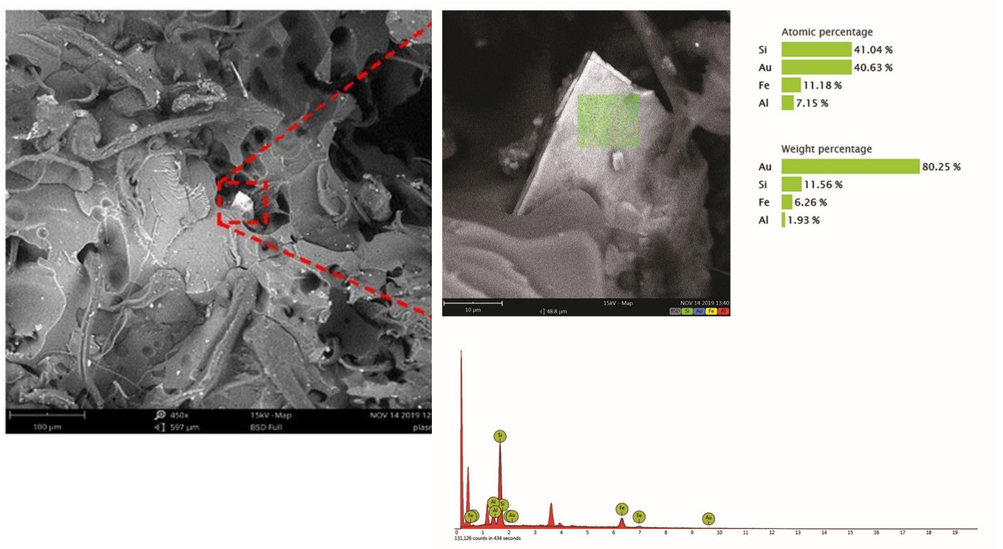
## Processing

The Plasmix was extruded in a twin-screw extruder at a temperature of 270 °C; polymer modified bitumen samples were prepared at 180°C using a high shear mixer at a rotational speed of 3000 rpm kept constant for 2 h.

## Characterization

The investigation of the composition has been made by flotation in water in order to separate a light fraction and a heavy fraction and by differential scanning calorimetry by using (Perkin Elmer DSC 7, USA). SEM EDAX analysis was made by using a Phenom X.
After mixing with the base bitumen, empirical tests such as penetration (for characterization at intermediate temperature) and softening point (for high temperature) were carried out on the modified binder produced. The dynamic viscosity was also measured with a Brookfield viscometer on modified binders.

# Discussion and Conclusion




From the analysis, a substantial heterogeneity of the material clearly emerges, especially as regards the presence of non-polymeric particles. the presence of Silicon and Gold with an atomic concentration of 41.04% and 40.63% respectively. Less representative, aluminum and ferrous components (7.5% and 11.18%). It is conceivable that among the components of Plasmix there is plastic material used for the construction of electronic circuits.

| Requirements | T intermediate | T high | Storage stability | Pumpability | Mixing temperature |
|---|---|---|---|---|---|
| **Characteristic** | Pen @ 25°C | $T_{R\&B}$ | $\Delta T_{R\&B}$ | η@135°C | T@2Pa·s |
| **Test method** | EN 1426 | EN 1427 | EN 13399 | EN 13702 | EN 13702 |
| **unit** | dmm | °C | °C | Pa·s | Pa·s |
| **Neat bitumen** | 50.5 | 67 | n.a. | 0.432 | 153 |
| **Bitumen 5% Plasmix (50/50)** | 39.9 | 59 | 7÷17 | 0.95 | 169 |
| **Bitumen 2% Plasmix (50/50)** | 52.4 | 55 | 1 | 0.682 | 159 |
| **Bitumen 2% Plasmix (90/10)** | 52.6 | 60 | 1 | 0.478 | 154 |

Considering that storage stability requirement for PMBs is ΔTR&B ≤ 5°C, results obtained for the bitumen modified with 5% of Plasmix 50/50 clearly indicate that these samples are to be considered as unstable: unreacted polymer was detected in bitumen and macroscopic phase separation occurred during its storage at high temperatures, which leads to undesirable problems during transportation of the binder and storage in plant. On the other hand, results for both the samples modified at 2% of Plasmix 50/50 and 2% of Plasmix 90/10 show a significant stability. For the same modified binders, viscosity at 135°C and mixing temperature results also prove the possibility of using adequate content or selected component of the Plasmix, in order to be used for pavement constructions.

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