# WEATHERING EFFECTS ON THE IMPACT, BULK AND SURFACE PROPERTIES OF POLYPHENYLENE SULPHIDE (PPS) COMPOSITES

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PPS composites are subjected to the weathering especially in outdoor applications like automotive applications (16). Colour and surface morphology changes and fracture comes into front as a major failure problem as a result of weathering. The major objectives of this investigation were to determine the weathering effects on the impact, bulk and surface properties of the PPS composites.

**a) Material:**
PPS composites are kindly supplied from Ticona-GERMANY as 80x80 mm plaques with the thickness of 2 mm. Two types of PPS composites are used in our study. Injection moulding grade, random short glass fibre reinforced (40% w/w) and Injection moulding grade, random short glass fibre and mineral particulate ($CaCO_3$) reinforced (65% w/w) PPS composites. Their traditional names are 1140L6 and 6165A4, respectively. Making easy to follow materials is coded. L-type materials represent 1140L6, and A-type materials represent 6165A4.

**b) Weathering Conditions:**
Natural weathering experiment is performed in izmit/Turkey. Charpy impact samples are replaced on the apparatus. Each sample was outdoor exposed on the roof of our research building from 1'st of May 2001 to 12'nd of September in 2001. Sample holder apparatus was placed on the roof to the south direction at an angle of elevation of 45. The geographic coordinate of the weathering test apparatus is 40.45 N and 29.55 E. The research building is nearby the İzmit bay of Marmara sea (Turkey). The distance from the sea is 250 m, and the altitude form the sea surface is 3 m. Both A and L-type samples are replaced into the same sample holder. At first stage naturally aged samples are tested after the weathering period of 2211 hours; other samples are tested after 3216 hours. Meteorological data's were kindly supplied from Turkish State Meteorological Service.

**c) Experimental Procedures:**

**Weight loss measurements:** There are 10 "pilot samples" are chosen with the dimensions of 10x65x2 (mm). Those ten weathering test samples are periodically (daily) balanced. The average weight of the 10 samples is taken into account. These pilot samples are used only in weight measurements. Samples are balanced at the Scaltec SBC 31 balance; with the accuracy of 0.1 mg. along the weight measurements special care is given to ensure the clean and dry surface.

**Instrumented charpy impact (ICI) tests:** Instrumented charpy impact tests (ICI) were performed on a Ceast pendulum type tester (Resil 25). Impact test samples were prepared according to ISO 179 standards. Un-notched samples with the dimensions of 10x65x2 mm were used. The span was 40 mm. Preliminary experiments were performed in order to find the appropriate falling angle, which was chosen to be 30° in order to remove the inertial oscillations in the contact load between striker and sample.

**SEM investigations**

The surfaces of the samples were examined by scanning electron microscopy, SEM, using a JOEL JSM-6335F field emission scanning electron microscope. Standard sample preparation procedure is followed for polymeric materials. Prior to these SEM observations, the surfaces were coated with a thin gold layer.

**Thermomechanical investigations**

For thermomechanical analysis (TMA) dimensions of 6x6x2 (mm) samples were mechanically cut carefully from the plaques under good cooling conditions in order to preserve micro structural deformations due to thermal effects. TMA tests were performed according to ASTM D 1545 standard by Shimadzu TMA analyzer (model TA-50). Normal load of 50 g and heating rate of 10 °C/min were selected as test parameters at "Expansion mode".

As a result of the impact studies it is observed that A-type materials although have a higher %weight loss has a lower %decrease in impact strength. As stated before all of the external effects have a potential risk for inducing the debonding, craze and micro crack formation especially at the reinforcement/matrix interface. Although there is more interfaces compared the L-type material (particle/matrix interfaces should be thinking as an additional interfaces beside the fibre/matrix interfaces) A-type materials not affected from the weathering as severely as the L-type materials. At that point, with evaluating the SEM results it is possible to say that, more micro cracks are formed during the weathering at the A-type materials. As a result of external effects this micro crack coalescence may happen but it induces many major cracks especially at the beginning of the impact loading. On the other hand higher number of interface formation result in forcing the cracks propagation into more zigzag formation, which result in more energy absorption. Considering the L-type material, as seen the SEM investigations there are lower number of interfaces (between the fibre and matrix) and fewer micro cracks formation occurs. When we consider the whole external effects focussed on the fewer micro cracks, it results in deeper and sharper micro cracks. This micro cracks are more convenient to coalesce and form the major cracks. For that reason the decrease in the impact performance is more dramatic compared to A-type materials. With this point A type materials seem preferable in using outdoors applications like automotive industry. As a result of the investigations A-type material with a high colour and dimensional stability seems highly convenient in outdoor applications.

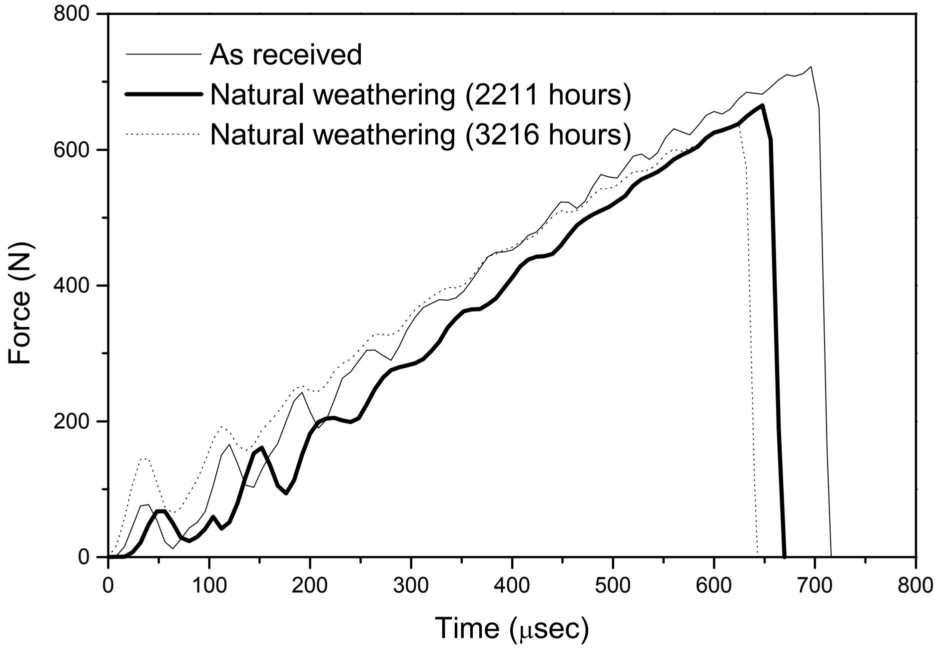


Fig 1 . ICI test results of naturally aged A type materials.

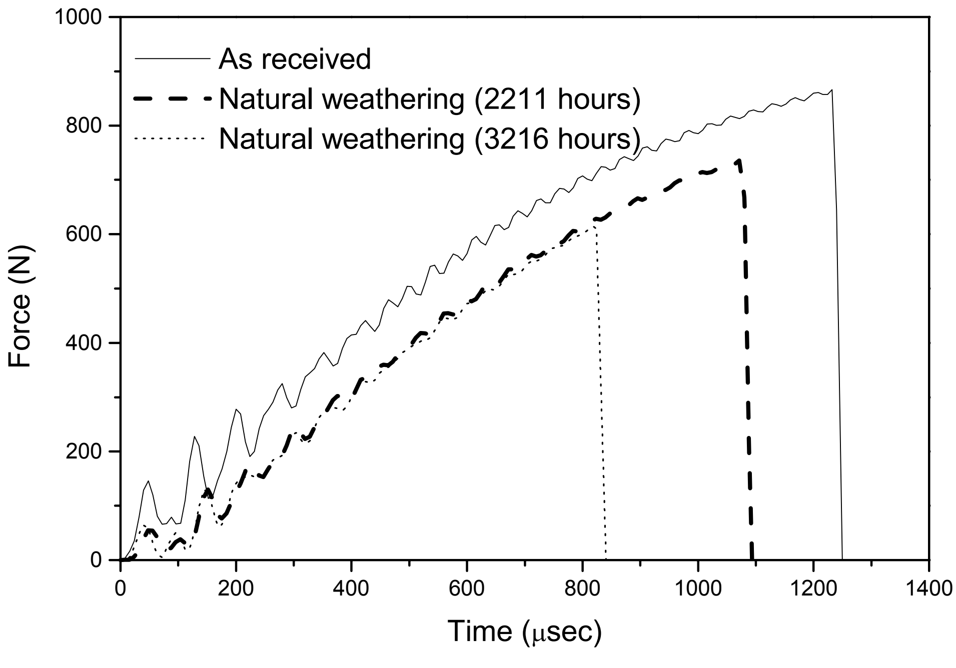


Fig 2. ICI test results of naturally aged L type materials.

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