Radiation Resistance of AURUM®

When a plastic is used in an electrical insulating material for a nuclear reactor, the radiation resistance of the plastic becomes a critical required property.

Generally, when radiation is applied to a plastic, the crosslinking of the molecules and the breaking of the main molecular chains take place at the same time. According to the proportion between them, plastics can be divided into two types: the crosslinking type and the breaking type.

For example, those plastics which have a molecular structure showing a high crosslinking rate (such as polyethylene) is called crosslinking-type polymers because their heat resistance, weathering resistance and stress cracking resistance are improved significantly by irradiation. Radiation is used as an effective means for improving the properties of plastics in some cases.

Generally, however, when a plastic is irradiated, the breaking of the main molecular chains takes place first due to the formation of double bonds, cis-trans transition, oxidation reaction, etc., causing a degradation of its properties.

AURUM® displays a behavior similar to that of a crosslinking-type polymer and has higher radiation resistance than that of the conventional thermosetting/thermoplastic polyimide resins or a representative high-performance resin PEEK.

Table 1 shows changes in the mechanical properties of plastics that took place when beta rays (electron beams) were irradiated, and Table 2 shows changes in the mechanical properties of plastics that took place when gamma rays (60Co) were irradiated. The changes are expressed in terms of retention percentage against the values as determined before irradiation.

The information contained herein is based on the information and data available at this moment, but none of the data or evaluation results contained herein provide any warranty whatsoever.
(Japan Atomic Energy Research Institute)

Table 1  Changes in Mechanical Properties of Plastics that Took Place When Beta Rays (Electron Beams) Were Irradiated: Retention Percentage (%)

<table>
<thead>
<tr>
<th>Irradiation (Mrads)</th>
<th>Tensile strength</th>
<th>Elongation at break</th>
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</thead>
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The information contained herein is based on the information and data available at this moment, but none of the data or evaluation results contained herein provide any warranty whatsoever.
Table 2  Changes in Mechanical Properties of Plastics that Took Place When Gamma Rays (60Co) Were Irradiated: Retention Percentage (%)

<table>
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Radiation Resistance of AURUM® (2)

Thermoplastic resins having a high heat resistance are required for use as the matrix resins of the carbon fiber reinforced plastics (CFRP) to be used in the aerospace field.

AURUM® is believed to be suitable for such uses because it exhibits a high glass transition temperature and a tendency for its high-temperature properties to be improved, rather than deteriorated, by irradiation of electron beams.

To illustrate the effects of irradiation of electron beams on the high-temperature properties of AURUM®, Fig. 1 shows changes in tensile strength, Fig. 2 changes in glass transition temperature, and Fig. 3 changes in stiffness.

(Japan Atomic Energy Research Institute)