Application Data Sheet for Polyethylene Masterbatch

FR-1410 is offered by ICL-IP as a flame retardant additive containing 82% aromatic bromine. Its high bromine content coupled with its exceptional thermal stability makes it the material of choice for a large variety of applications. Its chemical structure and properties are shown in Figure 1.

Main features about FR-1410 are:

- Its chemistry is not related with diphenyl oxide
- Being RoHS compliant, it can be used in the production and sales of electrical and electronic equipment in Europe
- It is commonly used in polyolefins (PP, PE and their copolymers), styrenic homo- and copolymers and several engineering thermoplastics like PBT and polyamides.
- It is suitable for both UL-94 V-2 and V-0 ratings.
- It offers an optimal balance of properties.

Figure 1: Chemical Structure and Properties of FR-1410

Decabromodiphenyl ethane

Bromine content, wt % 82
Melting point, °C > 350
Specific gravity 3.25
Molecular weight 971.2
Assay (HPLC), % > 99
Thermal stability

Thermogravimetric analysis of \textit{FR-1410} (Table 1) reflects its high thermal stability allowing high processing temperatures. Its thermal stability combined with excellent resistance to hydrolysis, makes it the product of choice when recyclability is an issue.

<table>
<thead>
<tr>
<th>Weight loss, %</th>
<th>Temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>322</td>
</tr>
<tr>
<td>5</td>
<td>345</td>
</tr>
<tr>
<td>10</td>
<td>360</td>
</tr>
</tbody>
</table>

Masterbatch formulation

\textit{FR-1410} can be loaded up to 85\% in a Masterbatch. In addition, \textit{FR-1410} can be combined with Antimony Trioxide as synergist in the same Masterbatch formulation. Such a formulation is typically based on a 4:1 ratio of Bromine to Antimony Trioxide, as shown in Table 1.

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>LDPE (MFI 2-4)</td>
<td>17.8</td>
</tr>
<tr>
<td>\textit{FR-1410}</td>
<td>68</td>
</tr>
<tr>
<td>Antimony trioxide</td>
<td>14</td>
</tr>
<tr>
<td>Antioxidant</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Depending on the final application and the standard to comply with, such a Masterbatch will be loaded at 15-35\% in the final plastic product (film, sheet, injection molded article).
Colorimetric results

Due to the relative **FR-1410** high concentration in the final article, it is important to closely monitor the shade of the Masterbatch. Chart 1 outlines **FR-1410 based** Masterbatch colorimetric performances, as measured by Datacolor SF-600 spectrophotometer, according to ASTM D-2244-79.

Chart 1: Comparative colorimetric data of 70% **FR-1410** and commercial DBDP Ethane based Masterbatches, vs. 100% white.

![Colorimetric Chart](image-url)
Dispersion

As known, a good dispersion is a sine qua none condition for maximizing Flame Retardancy properties of a given additive. As presented in Table 2, **FR-1410** exhibits the following Particle Size Distribution

<table>
<thead>
<tr>
<th>Typical values</th>
<th>µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10</td>
<td>2</td>
</tr>
<tr>
<td>D50</td>
<td>3.4</td>
</tr>
<tr>
<td>D90</td>
<td>6.1</td>
</tr>
</tbody>
</table>

The ability to achieve an excellent dispersion is based on Particle Size Distribution as well as on the particle’s morphology. A widely accepted tool for assessing quality of dispersion is the “Filter Test”, according to DIN-EN13900-5. Chart 2 shows Filter Pressure Values obtained with a 28% **FR-1410** PP compound based on a LDPE **FR-1410** Masterbatch (the lower the pressure and Delta P, the better the dispersion).

Chart 2: Filter Pressure Values for **FR-1410** and commercial DBDP Ethane in PP
Melt Flow Index

For Polymers and Plastics processors, masterbatch viscosity as expressed by Melt Flow Index value is an important property. LDPE Masterbatches based on a 70% loading of FR-1410 or commercial DBDP Ethane were tested for MFI. Results are presented in Chart 3 below. Testing was performed in accordance with ASTM D1238, at T=190°C and under load of 2.16 kg.

Chart 3: MFI results for 70% FR-1410/commercial DBDP Ethane in LDPE MB

Health – Safety - Environmental aspects

Decabromodiphenyl ethane, a mature product in the market, has undergone extensive toxicological and environmental testing\(^1\), and has been proven to pose no risk to health and the environment for its recommended end-uses. FR-1410’s chemical structure is designed to eliminate any risk of formation of brominated dioxins and/or furans. As part of an ongoing Product Stewardship Program and Customer oriented policy, ICL-IP is committed to implement further toxicological and environmental tests if needed.

\(^1\) Further information available upon request

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Applications

Recommended applications of FR-1410 in Polyolefins are: housings of electrical appliances, connectors, acoustic ceiling, wire and cables, sheets, pipes and films for various uses in E&E, appliances and building industry (see Figures 1 to 8).

In these applications, FR-1410 exhibits inherent advantages over other products: cost-efficiency, fairly good impact and thermal stability. FR-1410 is suitable for applications with UV or light exposure.

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