Acoustic Parameters of High Functional Plastics
—Measurement of Acoustic Velocities (Wave Propagation Velocities)

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Abstract: Recently, high functional plastics (so called engineering plastics) which improved the weak point of conventional plastics have been used in the industry. The acoustic parameters of these engineering plastics in the high frequency have been scarcely reported in the literature.

In this study, the acoustic velocities (wave propagation velocities) of engineering plastics were measured using the scanning acoustic microscope in the range from 50MHz to 200MHz. And, the velocities were compared with the velocities reported in the literature at the lower frequencies.

SCANNING ACOUSTIC MICROSCOPE

The blockdiagram of the scanning acoustic microscope HASM210 (HITACHI) used was shown in Fig 1. When the plane wave generated by a transducer incidents the specimen through the acoustic lens,

\[ V_s = V_w/\{1 - (1 - V_w/2F \Delta z)\} \]  \hspace{1cm} (1)

where, \( V_w \) is the acoustic velocity of the coupler (water) at 20 °C, \( F \) is the frequency of the ultrasonic wave, and \( \Delta z \) is the fluctuation period of the \( V(z) \) curve.

EXPERIMENT AND RESULTS

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$V(z)$ curves for several plastics were measured by the use of the scanning acoustic microscope. Specimens were PMMA (polymethylmethacrylate), PEEK (polyetheretherketone), Unilite (polymethyleneterephthalate), UPE (ultrahigh polymer), Econole (polyoxybenzylene), POM (polyacetal) with 10mm thick, respectively. Fig. 2 shows the $V(z)$ curve for PMMA at 100MHz. From this curve, distance $\Delta z$ between adjacent two "valley parts" were measured and calculated the surface velocity of several specimens from eq. (1). These results at 100MHz were shown table 1. Furthermore, usual results measured at 2MHz using the pulse echo method were compared[2].

**FIGURE 2. $V(z)$ curve for PMMA at the Ultrasonic Frequency 100MHz**

**TABLE 1. Density and Acoustic Velocity of Engineering Plastics**

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Density</th>
<th>Acoustic Velocity (m/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2MHz</td>
</tr>
<tr>
<td>polymethylmethacrylate</td>
<td>1.19</td>
<td>2720</td>
</tr>
<tr>
<td>polyetheretherketone</td>
<td>1.30</td>
<td>2450</td>
</tr>
<tr>
<td>polyethylene terephthalate</td>
<td>1.50</td>
<td>2452</td>
</tr>
<tr>
<td>polyoxybenzylene</td>
<td>1.90</td>
<td>1488</td>
</tr>
<tr>
<td>polyacetal</td>
<td>1.42</td>
<td>2270</td>
</tr>
</tbody>
</table>

Acoustic velocities were measured at the ultrasonic frequencies 2MHz and 100MHz.

**CONCLUSION**

The velocities of several plastics about ultrasonic frequency 100MHz were measured. It is revealed that measured velocities about 100MHz have an little influence on these high frequencies. Consequently, it was concluded that about the velocities, conventional methods were able to use even if the ultrasonic frequency was higher.

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**REFERENCES**