The Eden Project in Cornwall has quickly established itself as one of the most popular paid-for attractions in the UK, drawing in over 1.5 million visitors a year. The exhibits on show in the site’s huge biomes encourage visitors to consider the relationship between plants and people.

Two years ago the Eden Project, in conjunction with Fuchs Lubricants and McAlpine, identified an opportunity to demonstrate the use of plant-based hydraulic fluids during the construction of a new Education Resource Centre, a building that has become an exemplar of sustainable construction. These lubricants had already been successfully used in club cars and other vehicles at the site, and the new construction project allowed their use to be demonstrated to the public during the building phase.

The principle sources of biolubricants are renewable and harvestable materials, such as seed crops (eg oil seed rape) and their derivatives. This contrasts sharply with more conventional lubricants based on mineral oils.

**Biolubricant Success**

**at the Eden Project**

By Cliff Lea, Fuchs Lubricants UK plc

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Mobile Plant Maintenance

An IHI excavator running on biolubricant at the Eden Project

very low coefficient of friction. After further refining and modification, downstream esters from vegetable oils offer even greater advantages and such materials are preferred for highly stressed and high-temperature applications.

Indeed, many are used simply for their advanced performance characteristics – their use for the formulation of specialty racing and competition lubricants is one prime and well-respected area. However, a more recent driver for the introduction of biolubricants has been the sharp rise in the cost of mineral oils. It is clearly important for UK plc to look to the use of indigenous renewable resources in view of growing trade imbalances and the severe predictions for the future.

The rapidly rising cost of mineral oil-based lubricants is currently causing great concern in the market, with obvious positive implications for harvestable resources. As already mentioned, one of the most attractive benefits of crop-based lubricants is their much lower coefficient of friction, which can lead to reduced energy consumption for almost any items of equipment in which they are used.

At the Eden Project a number of vehicles and equipment were selected to use the plant-based lubricants, principally to demonstrate their use in hydraulic systems, but in some cases also using engine, transmission, and bearing greases. These vehicles included a number owned by Highway Plant Ltd and operated by McApline, such as a Merlo telehandler, an IHI excavator and a Barford dumptruck.

Oil condition monitoring

The main aim of the project was to demonstrate the use of hydraulic fluid derived from renewable resources, and to track oil and equipment condition over an extended period of time in stressed applications within the very dusty and demanding atmosphere of the Eden Project construction site.

Oil samples were taken at regular intervals and submitted for laboratory analysis. None of the test hydraulic fluids had to be changed during the almost two-year trial period and no mechanical problems were reported.

Table 1. Comparison: wear metal (ppm) increase within the oil over the life of the trial, showing considerably higher wear during typical use of mineral oil, and extremely low wear rates with crop-based oil

<table>
<thead>
<tr>
<th>Lubricant</th>
<th>Equipment</th>
<th>Iron (Fe)</th>
<th>Chromium (Cr)</th>
<th>Aluminium (Al)</th>
<th>Copper (Cu)</th>
<th>Lead (Pb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral hydraulic oil</td>
<td>Shovel</td>
<td>25</td>
<td>5</td>
<td>8</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>(ISO 6743-3, HM VG 46)</td>
<td>Excavator</td>
<td>35</td>
<td>13</td>
<td>13</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>Biofluid (Fuchs Plantosyn</td>
<td>Barford</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>46HVI)</td>
<td>dumptruck</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IHI excavator</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Merlo</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

The tests tracked changes in viscosity and checked for cross-contamination from dust, dirt, water etc. In particular, to monitor for any wear occurring within the vehicles and equipment, particle analysis was carried out on all major metals picked up by the oil, including common wear or corrosion components from ferrous, copper-based alloys, aluminium, steels etc. The results showed excellent stability with viscosity and oil condition maintained from the start of the trial in spring 2004 to January 2006. Full analysis results are shown in table 1.

Comparison with mineral oil

The results showed that the crop-based fluids gave a high level of protection, with extremely low levels of wear metals detected in the oil, despite the equipment operating in a dusty china clay quarry environment.

Compared with similar equipment using mineral oil, typical levels of wear metals, such as iron, chromium, copper and aluminium, were a factor of 10 times lower. This suggests that equipment life may be considerably extended through the use of biofluids from renewable resources, in place of mineral oils.

Conclusions

Plant-based lubricants have been trialled in very dusty and demanding conditions during new construction at the Eden Project. The trials lasted for almost two years and the results showed that these fluids gave excellent and dependable performance with no mechanical problems reported. Oil condition in the hydraulic systems continued quite satisfactorily throughout the trial without the need for change. In particular, the main test equipment showed extremely low metal wear rates, a factor particularly commented on by the test laboratory.

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