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Aroclor 1242 Dielectric vs.  
Trichlorobiphenyl Oxide  
Dielectric

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The subject comparison is not new. Physically and electrically the two dielectrics are remarkably similar. Selection has been strictly an economic and availability consideration, favoring Aroclor.

Eighteen years ago when Aroclor 1242 delivered at 14.00 cents a pound, GE said that they would switch to tri-chlorobiphenyl oxide immediately if the material was available in the amount needed at the same price as Aroclor. At that time GE merely saw the advantage of the minus 24°C pour point of trichlorobiphenyloxyde vs. the similar value of Aroclor 1242 at minus 17°C.

Today Aroclor is priced at 18.00 cents a pound delivered and a number of things changed that bear on the use or selection of these materials, not only for capacitors but now also for transformers.

Each change on factor appears to favor trichlorobiphenyl oxide to at least a slight degree.

Of course the economic and availability factors dominate and continue the obvious reasons why trichlorobiphenyl oxide is still on the side lines.

#### Estimated Cost Comparisons

Today the bulk and 20 W plus pound manufacturing cost for the materials is believed to be about as follows:

- |                                                                                               |           |
|-----------------------------------------------------------------------------------------------|-----------|
| a) Aroclor 1242                                                                               | 7.4¢/lb.  |
| b) Trichlorobiphenyl oxide using biphenyloxyde available as by product from a phenol process. | 9.1¢/lb.  |
| c) Trichlorobiphenyloxyde, using biphenyloxyde produced directly from phenol dehydration.     | 11.1¢/lb. |

(The above cost advantage given for Aroclor in the USA is probably not as large in the UK.)

The question is whether the 1.7¢ cost spread between (a and b) and the 3.7¢ cost spread between (a and c) warrant quantifying the physical, electrical and ecological differences in these materials.

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The following physical comparisons are readily available from the literature:

|                                                  | <u>Aroclor<br/>1242</u> | <u>Trichlorobiphenyl<br/>oxide</u> |
|--------------------------------------------------|-------------------------|------------------------------------|
| RI 25°C                                          | 1.6240-1.6260           | 1.6030                             |
| Fire point                                       | none to boiling         | none to boiling                    |
| Specific Gravity<br>25/15.5°C                    | 1.381-1.392             | 1.390                              |
| Viscosity SUS (37.8°C)                           | 82-92                   | 52*                                |
| Pour Point°C                                     | -17                     | -24*                               |
| Distillation range at<br>15mm; °C                | -                       | 210-220                            |
| at atmosphere °C                                 | 325-360                 |                                    |
| Dielectric Strength<br>KV at 25°C                | 35                      | 35                                 |
| Resistivity, ohm-cm x 10 <sup>9</sup> ,<br>100°C | 100                     | 100                                |
| Dielectric Constant, 60 Hz;<br>100°C             | 4.7-4.9*                | 4.2                                |

#### Comments

- I. The lower viscosity of trichlorobiphenyl oxide would allow lower temperature impregnation of paper capacitors and should facilitate impregnation of film capacitors.

However, a more significant advantage that should be explored is the anticipated higher compatibility of trichlorobiphenyl oxide with PPL film.

- II. The lower pour point is of some advantage for power capacitors, in cold climates. Aroclor is believed suitable for capacitors at minus 40°C, but some believe not suitable for minus 50°C. The 7 degree lower pour point of trichlorobiphenyl oxide appears of interest, here.

The lower pour point appears of definite interest for transformers as it comes closer to meeting the minus 25 to minus 30°C sought.

- III. The lower dielectric constant of trichlorobiphenyloxide is an immediate measurable economic disadvantage for paper capacitors. However, we have means for raising it with additives, recently found suitable. However, with the advent of film capacitors the slightly lower DK is no longer a drawback in power capacitors and it is desirable for transformers.

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- IV. Containing an oxygen in the molecule trichlorobiphenyl ether would be expected to form less carbon on arcing than is the case with Aroclor 1242. Also the arc formed gas may be slightly less flammable. However, it seems doubtful that any significant difference could be found, especially in practical terms of application.
- V. A possible more valuable difference resulting from the presence of oxygen is thought that trichlorobiphenyl-oxide should be more biodegradeable than Aroclor 1242.

If a worthwhile advantage were discovered regarding biodegradeability, it could be the most weighty factor against Aroclor.

#### Recommendation

1. The above given comparative manufacturing costs should be rechecked and potential product availability understood, relative to both the USA and the UK.
2. The biodegradeability of trichlorobiphenyl oxide should be determined and compared against Aroclor 1242 and MCS 1016.
3. The arcing characteristics of trichlorobiphenyl oxide relative to carbon formation should be compared; the composition of the arc-formed gas should be determined and the combustibility compared against our data for Aroclor 1242.
4. The degree of expected better compatibility with PPL film should be determined.
5. If these physical or ecological factors are found favorable, judgements and estimates should be made about the possible total replacement of electrical Aroclor 1242 with trichlorobiphenyl oxide.

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