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RECEIVED

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J. F. BROWN JR.

Dr. John F. Brown
Manager, Life Sciences Branch
Physical Chemistry Laboratory
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GE Company
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P.O. Box 8
Schenectady, NY 12301

Dear Dr. Brown:

The following additional data and comments is offered in response to the questions raised in your letter of October 17th about our initial report:

1. Evidence for Chlorine Redistribution. Realizing the unusual nature of such a redistribution process, we continued to look for an explanation for this. What we have found is that the chlorodiphenylethers start eluting from alumina with 3% methylene chloride in hexane; although they are also present in the 20% methylene chloride in hexane fraction as well. Additional chromatography of the 3% fraction using 1% methylene chloride will remove most of the diphenylethers from the PCB fraction at the cost of decreasing the total recovery of PCBs. There is no evidence, however, for selective loss of PCBs. The GLC of the extensively purified PCB fractions of used transformer fluid gave a very good pattern match for Aroclor 1260. A few extra peaks can be shown to be residual chlorodiphenylethers by GC/MS. We do not see any PCB isomers that are not present in 1260. Therefore, the complex pattern which was thought to be a rearranged or redistributed PCB is in fact a mixture of PCB isomers characteristic of 1260 along with the chlorinated diphenylethers.

Since our preliminary examination of the fluids (chromatography, etc.) was finished before the mass spec group identified a large amount of diphenylether in the PCB fraction, the specific need to remove them to obtain a PCB GLC pattern could not be known prior to consideration of the data in total. The only clue to a discrepancy was the finding that the RIA assay indicated we did have an Aroclor mixture. It is possible that the 1260 mixture already represents a thermodynamic "sink" of the most stable PCBs. For example, 2,3,4 substitution patterns, representing severe steric crowding, are more common to 1254 than 1260. 2,3,5-patterns are more common to 1260 than 1254.

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With regard to the complex mixture of chlorinated benzenes, it cannot be said with certainty that this is the result of chlorine redistribution. However, it is difficult for me to accept that such a complex mixture of chlorinated benzenes would be conveniently available for makeup fluid.

2. Evidence for Formation of Polychlorinated Diphenylethers in Use. Certain fragments of the chlorinated diphenylethers can give rise to ions identical to those of certain chlorinated furans. This doesn't mean that one cannot analyze for the furans, only that you must be aware of this possible problem and monitor characteristic ions of both classes of compounds. This was done without difficulty for the new transformer fluid but with considerable difficulty in the used fluid when large quantities of diphenylethers were present.

There is no doubt that new transformer fluid fraction 2A contains chlorinated diphenylethers. This was established by examination of mass spectra of the components. However, the levels are from 5 to 50 times lower than in the old transformer fluid. Again, one cannot say with certainty that these increased levels of chlorinated diphenyl ethers are the result of use conditions. But if commercial mixtures of these compounds were available, it is difficult to understand how they could have been predominately the highly chlorinated isomers as indicated in this study. There is a conspicuous absence of the lower chlorinated diphenylethers suggesting a unique mechanism for their formation, perhaps via the highly chlorinated benzenes.

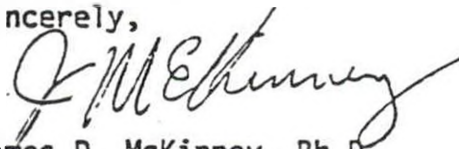
3. Evidence for Polychlorinated Dibenzofurans in Unused Oil. The level of what was called hexachlorinated dibenzofuran in new transformer fluid fraction 4B was estimated at 10 ppm. This value referred to its concentration in that fraction, thus 10 ppm in fraction 4B would translate into about 1.7 ppm in the original sample. This value would be in reasonable correspondence with other investigators analyses of Aroclors for dibenzofuran content.

However, I feel that the real inconsistencies lie in the finding that the hexachlorinated dibenzofuran is the only isomer found in addition to the fact that it appears in the "wrong" fraction. To investigate this further, this fraction was rechromatographed on alumina using 3% methylene chloride (in hexane), 20% methylene chloride (in hexane) and 100% methylene chloride fractions. Under these conditions, the component previously identified as the hexachlorinated dibenzofuran was found in the 100% fraction. In other words, this "furan" has now appeared in the wrong fraction using two different column chromatographic conditions and does not give a predicted fragment ion ($M-COCl$). Unfortunately, this negative evidence is not sufficient to be certain the compound is not a furan nor does it identify it. It would appear that the only way this can be done at this point is to isolate enough material for an exact mass measurement.

However, I am not convinced at this point that the necessary work effort is justified in view of the rather low concentration in the total mixture.

In summary, I have probably raised as many new questions as those I have answered. Again, however, there are probably representative trends and patterns identified here which deserve further attention. It is clear at this point that we can only report what is there and can say very little, if anything, about how it got there. In view of this, I don't feel that further detailed chemical analysis is justified on these mixtures. In consideration of these follow-up data and comments, if you should have any additional questions, please do not hesitate to contact me directly. If you should desire the raw data (chromatogram, spectra, etc.), we would be glad to provide it on request.

Sincerely,



James D. McKinney, Ph.D.
Head, Chemistry Section, EBCB

cc: Dr. Moore
Dr. Albro
Dr. Hass