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To: • Dr. T. S. Osdene  
From: • R. W. Jenkins  
Subject: • Significant Scientific Accomplishments of our past  $^{210}\text{Po}$  Research Studies

CONFIDENTIAL

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1) During our several start and stop research studies on determining the  $^{210}\text{Pb}$ - $^{210}\text{Bi}$ - $^{210}\text{Po}$  contents in tobacco and smoke condensate, several definite conclusions were reached. These studies were divided into three phases:

- 1) To establish radioanalytical techniques to verify or disprove the analytical data as presented by Martell regarding the insoluble residue in whole smoke condensate (WSC).
- 2) To determine the "soluble"  $^{210}\text{Po}$  in tobacco and WSC.
- 3) To determine the actual transfer to WSC of the  $^{210}\text{Pb}$ - $^{210}\text{Bi}$ - $^{210}\text{Po}$  isotopes.

In phases 1 and 2, the following summary is given:

- 1) There is, by E. A. Martell's definition, a water insoluble residue in cigarette MS WSC and the data generated by us on the specific  $^{210}\text{Po}$  activity of the residue are in general agreement with, but show values 2 to 3 times lower than, those published by Martell.
- 2) The heating steps employed in the analytical procedure of Martell raise by a factor of 2 the specific activity of the insoluble residue in MS WSC.
- 3) Cellulose acetate filters do not alter the specific activity of the insoluble residue in MS WSC but do reduce the soluble  $^{210}\text{Po}$  content per gram of WSC by approximately 50%.
- 4) The average soluble  $^{210}\text{Po}$  content of WSC from all cigarettes tested varied from 0.5 to 1.0 pCi/g WSC, regardless of filter configuration or lack of it.
- 5) The inclusion of resin containing filters similar to those used by Bretthauer and Black did not result in any selective filtration of the "soluble"  $^{210}\text{Po}$ , but only a reduction in proportion to the overall reduction of the total smoke.
- 6) The procedure of Radford and Martell for using the  $^{210}\text{Po}$  deposited in lungs as an index of the residence times for calculating insoluble particles is invalid as stated because of the assumption that at the time of smoking, the  $^{210}\text{Po}$  to  $^{210}\text{Pb}$  ratio is zero, an assumption proved incorrect by this study. Instead the ratio has been shown to be near unity (secular equilibrium).

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- 7) The  $^{210}\text{Pb}$  and  $^{210}\text{Po}$  in the Martell "insolubles" are in radioactive equilibrium with each other at the time of smoking. In contrast, the "soluble"  $^{210}\text{Po}$  to  $^{210}\text{Pb}$  ratio is about 2:1.
- 8)  $^{210}\text{Po}$  exists in smoke in two different forms:
  - a) "Soluble"  $^{210}\text{Po}$  which is carried into the smoke stream in a "vapor" state and subsequently condensed into the smoke aerosol.
  - b) "Insoluble"  $^{210}\text{Po}$  which enters the smoke stream in equilibrium with its parent  $^{210}\text{Pb}$ , presumably by mechanical transfer of an intact nonvolatile particle with an unknown  $^{210}\text{Po}$  chemical composition.
- 9) A mechanism of smoke formation of the insoluble particles is presented. Natural atmospheric particles are deposited onto the sticky tobacco leaf surface and, when burned, simply are incorporated intact into the mainstream smoke stream by "mechanical entrainment."
- 10) The relative importance of the "insoluble"  $^{210}\text{Pb}$  and  $^{210}\text{Po}$  to the total  $^{210}\text{Pb}$  in the lungs of smokers obtained from cigarette smoke (E. A. Martell hypothesis) to that  $^{210}\text{Pb}$  and  $^{210}\text{Po}$  from the deposition from naturally occurring atmospheric particulate (P. J. Walsh hypothesis) is still an open subject.


In phase 3, in a cooperative study with Dr. T. C. Tso, USDA, tobacco was grown hydroponically in a medium containing soluble  $^{210}\text{Pb}(\text{NO}_3)_2$ . This tobacco was cured, made into cigarettes and smoked. The distribution of  $^{210}\text{Po}$ , which had ingrown from  $^{210}\text{Pb}$ , was determined. The  $^{210}\text{Po}$  transferred to MS WSC was 18.9% and to sidestream (SS) 45% of the amount consumed during smoking. Likewise for  $^{210}\text{Pb}$ , MS was 2.4% and SS was 3.7%. For  $^{210}\text{Bi}$ , values of 8.3% for MS and 5.5% for SS were determined. The difference in transfer rates between these elements is due primarily to different respective compound volatilities in the burning cigarette.

In light of the recent proposed paper by Martell, the publication of our results would serve to offer an alternative interpretation to the world's scientific community. Several of our findings, especially that of secular equilibrium of  $^{210}\text{Pb}$ - $^{210}\text{Po}$  at the time of smoking (#6), would directly challenge the scientific credibility of Martell and Radford, and perhaps would cause the public to realize that this issue is indeed just an unproven controversy, not fact. Also, other authors would be more hesitant to accept Martell's scenario as is, but only view them as hypothetical situations until proven.

/ds

Enclosures (2)

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