# MANUSCRIPT REVIEW BOARD INFORMATION SHEET

MANUSCRIPT TITLE: Naturally Occurring $^{222}$Radon Daughters in Tobacco and Smoke Condensate

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## ABSTRACT


The presence of low level α-radioactivity in tobacco and smoke as well as in most plant materials has been reported for many years. In 1974, E. A. Martell presented a theory on the airborne deposition of insoluble $^{210}$Pb containing particles onto the sticky trichomes of tobacco. He proposed that these trichomes were enriched in $^{210}$Pb and upon smoking of cigarettes, transfer intact into mainstream smoke in an insoluble fashion. The insoluble particles then remain in the smoker until the ingrowth and decay of $^{210}$Po takes place.

The study presented here is concerned with determining a) the presence of any insoluble materials in tobacco smoke which contain enriched levels of $^{210}$Pb, b) the degree of enrichment in $^{210}$Pb, and c) the presence or absence of secular equilibrium in the $^{210}$Pb - $^{210}$Po that may be in any insoluble materials in smoke. In summary this study shows:

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 $^{210}$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 $^{210}$Po content per gram of WSC by approximately 50%.
4. The average soluble $^{210}$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 procedure of Radford and Martell for using the $^{210}$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 $^{210}$Po to $^{210}$Pb ratio is zero, an assumption proved incorrect by this study. Instead the ratio has been shown to be near unity (secular equilibrium)
6. The $^{210}$Pb and $^{210}$Po in the Martell "insolubles" are in radioactive equilibrium with each other at the time of smoking. In contrast, the "soluble"


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$^{210}Po$ to $^{210}Pb$ ratio is about 2:1.

7. $^{210}Po$ exists in smoke in two different forms: a) "Soluble" $^{210}Po$ which is carried into the smoke stream in a "vapor" state and subsequently condensed into the smoke aerosol. b) "Insoluble" $^{210}Po$ which enters the smoke stream in equilibrium with its parent $^{210}Pb$, presumably by mechanical transfer of an intact nonvolatile particle with an unknown $^{210}Po$ chemical composition.

8. 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".