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THE RELATIONSHIP BETWEEN THE GROWTH FACTOR OF SMOKE
AND ITS DEPOSITION IN THE HUMAN LUNG

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SUMMARY AND RECOMMENDATIONS

Previous studies have shown that when smoke particles are exposed to a very high relative humidity (about 99%) in a plastic sponge, they grow by the condensation of water vapour at a rate and to an extent which is likely to increase their deposition in the human lung. It was also shown that among the factors which influence the extent of growth were the tobacco type, the degree of ventilation and the use of humectants. Measurements have now been made of the deposition of smoke particles in the human lung; one smoker puffed the cigarettes, and he inhaled and exhaled the smoke under controlled conditions.

The results support the view that the lung deposition is related to the hygroscopic properties of the particles. With the exception of the measurements relating to two types of cigarette which contained non-tobacco smoking materials, the results closely follow the relationship:

$$\text{percentage deposited} = 23 + 74 \log (\text{growth factor}).$$

The relationship indicates that only 23% of the particulate matter in non-hygroscopic smoke would deposit in the lungs, a value which is in

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good agreement with published data for non-hygroscopic particles, and equal to about one-third of the measured level for non-ventilated tobacco-containing cigarettes without humectants. The measured depositions range between 42%, for a ventilated cigarette containing air-cured fermented tobacco, and 83% for a cigarette with flue-cured tobacco and containing added glycerol; thus they vary by almost a factor of two.

Studies of the puff-by-puff retention of particulate matter did not show a trend except in the case of the ventilated air-cured fermented cigarette, for which the retention increased in the later puffs; this may reflect the decreasing degree of ventilation as the cigarette burns.

The retention of nicotine has also been measured and, as expected, it was found to be high: all the results were greater than 91% with the exception that for the ventilated cigarette containing air-cured tobacco, the retention was slightly lower (85%) because of the lower particulate deposition. Thus the ratio of nicotine deposition to particulate deposition can be varied over a range of 1.1 to 2.0, using conventional parameters of cigarette design.

Exploitation of this finding should be aided by two further studies: firstly, of the reactions of a larger number of smokers to the two extremes of the present range; and secondly, of techniques for extending that range.

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