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Princeton Paper*

Princeton University SCHOOL OF ENGINEERING AND APPLIED SCIENCE
DEPARTMENT OF AEROSPACE AND MECHANICAL SCIENCES
GUGGENHEIM AEROSPACE PROPULSION LABORATORIES

February 9, 1972

Dr. Helmut Wakeham
Vice-President for Research & Development
Philip Morris Incorporated
Research Center
4201 Commerce Road
Richmond, Virginia 23261

Dear Dr. Wakeham:

This letter is being written as a companion to the Research Sponsorship Agreement that has been signed by the University and has been mailed to you recently in a separate envelope. It was recommended by Dr. Lowitz that I place my statement of research directions for the first year in a letter rather than in the basic agreement.

Accordingly, we declare that we intend to perform the following tasks within the \$54,000/year level of funding specified in the Research Sponsorship Agreement:

1. Theoretical development and computer solution of an approximate first model:

This model will serve primarily to demonstrate the feasibility of varying the smoke composition output via selected changes in input cigarette design parameters. The theoretical model will have to be simplified in several aspects (since it will be formulated without awaiting any experimental data) and will incorporate best-guess values for physical and chemical parameters. The specific material toward which this task and those below will be initially oriented may be a simplified analog of tobacco such as cellulose.

2. Exploratory probing of the chemical structure of the combustion wave:

This task includes (1) the development of a suitable probe and servo-feed system for probe positioning, (2) development of a suitable analytical system, and (3) systematic sampling, first in the artificial cigarette and then in real tobacco cigarettes. The probing at this stage will be confined

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to interesting gaseous species such as N_2 , CO, O_2 , NO, and CH_4 . The results should provide valuable insights into the structure of the combustion wave and aid in defining the appropriate ranges for experimental determination of rates of pyrolysis, pyrosynthesis, etc. They will also provide data for checking the theoretical model.

3. Exploration of the thermal structure of the combustion wave:

This applies to both the artificial cigarettes and real tobacco cigarettes. The results complement those of Task 2 above. It is of importance in this probing to attempt to separately distinguish the gas and condensed phase temperature at each point in the reaction wave. Radiation analysis techniques as well as fine thermocouples will be examined.

If this meets with the approval of Philip Morris, then please sign the duplicate copy of this letter and mail it back to me.

Very truly yours,

Martin Summerfield
Professor of Engineering
for
PRINCETON UNIVERSITY

Approved by:

_____ (Signature)

_____ (Typed Name)

_____ (Title)

FOR PHILIP MORRIS, INC.

cc: Dr. Thomas S. Osdene
✓ Dr. David A. Lowitz

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