

**COLLEGE OF ENGINEERING
Chemical Engineering**

**SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN**

APPLICATION DEADLINE: MARCH 1, 2005

The Department of Chemical Engineering is pleased to offer the following research project for the summer of 2005. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and if possible, develop a timetable for the twelve-week research period.

Membrane Fouling During Microfiltration

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Fouling is a major problem in membrane processes that causes a reduction in filtration flux over time. For example, the efficiency of microfiltration (MF) for the production of many pharmaceutical products is adversely affected by fouling, especially that associated with the presence of bacteria or protein in the feed stream(s). Overall, membrane fouling is a complex phenomenon that depends upon the type of foulant(s), the feed concentration, temperature, pH, and ionic strength, and separation system hydrodynamics¹. The interplay among these many factors has made a comprehensive understanding of fouling difficult to obtain. Nonetheless, a promising approach for improving understanding of the various fouling mechanisms involves the development of practical models, which can be quantitatively validated using data from actual membrane operations.

Previous models of protein fouling have generally employed classical approaches: (1) pore blockage, (2) pore constriction, or (3) cake filtration. These models often show significant discrepancies with filtrate flux data. Ho and Zydny^{2,3} have developed a mathematical model for predicting filtrate flux that simultaneously accounts for (1) initial fouling due to surface pore blockage, (2) subsequent fouling due to the growth of a protein deposit over the initially blocked regions, and (3) effects of membrane morphology on the internal flow profiles within membranes. Calculations from this comprehensive model are in good agreement with experimental fouling data obtained with a wide range of proteins using composite and isotropic membranes^{4,5}. Despite these advantages, the model completely neglects the effects of internal fouling, i.e., adsorption of proteins within the pore structure of the membranes. Internal fouling can significantly alter the retention characteristics of membranes and in some cases (e.g., relatively clean feed streams or chemically modified membranes resistant to surface fouling) represents the dominant fouling mechanism.

The overall goal of this research is to utilize a complementary modeling and experimental approach to develop a comprehensive understanding of membrane fouling by commercially significant biopolymers during MF. The specific objectives include:

- 1. Develop a mathematical model that accounts for the effects of membrane pore structure on retention and flux decline behavior.
- 2. Select a suitable model feed in conjunction with an appropriate series of MF membranes such that the effects of systematic changes in these feed/morphology parameters on fouling behavior can be evaluated.

The students will learn membrane science and technology and bioseparations that is commonly used in biotech industries.