Microencapsulation Studies for Mass Production of IFE Targets*

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Future Inertial Fusion Energy (IFE) power plant operation will require mass production of IFE targets at a minimum of 500,000 capsules per day. With this in mind, we are investigating methods commonly used in the chemical industry to study scale-up opportunities and methods of reducing costs associated with mass production. The goals of these studies are to provide a stock of capsules (mandrels) for coating studies and to design and test apparatus more suitable for mass production of direct and indirect drive capsules.

All aspects of the laboratory scale process, including apparatus, procedures, and assumptions, were examined and reviewed for ease of scalability and adaptability to continuous target production. Microencapsulation, utilizing a triple orifice generator combining two aqueous phases and one organic phase, is employed for fabrication of capsules. Several parametric studies are being undertaken, as the effect of microencapsulation process variables on the final product are highly intertwined. For example, during curing of the capsules, water bath temperature alone affects solvent removal rate, oil solubility, density of each phase, viscosity of the various solutions, and interfacial surface tension. One easily identified goal in scale-up development is the optimization of curing time for polystyrene capsules. A prototype gas agitated contactor has been designed, built, and tested in order to study the optimization of curing time. Important considerations in the optimization are the rate of solvent extraction from the plastic capsule and nucleation of gas bubbles in the inner aqueous phase during drying. Results of tests using the gas agitated contactor are presented including results using alternative washing solutions for cleaning the shells. Other processes identified for scale-up development are also presented.

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