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Experiences from tritium breeding experiments in molten salts

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We have undertaken tritium breeding experiments using 14.1 MeV neutron generators for irradiation of capsules filled with molten salts (C₁LiF and FLiBe) at temperatures 600C - 700C. Tritium that is bred in the salt is collected by sweep gas into bubblers and then analyzed with Liquid Scintillation Counting. The collected tritium is compared to measured neutron fluences from the neutron generators via activation foils and diamond neutron detectors. The experimentally determined tritium breeding ratio (TBR) of collected tritium to neutron output is compared to neutronics simulations with salt volumes of 100 mL to 1 L and TBRs of 10^{-4} - 10^{-3} . The tritium releases from the two collection streams (surface release and wall permeation) are fitted using a simplified mass transport model with good agreement and only mass transport coefficients as free parameters. Advancement of the release model is underway to include greater detail and improved understanding of the tritium transport in the system. The goals of these experiments are just to study the behavior of tritium in breeder blankets, but also to project towards fusion reactor applications. Next steps include experiments with additional breeder types (lithium-lead and lithium oxide), further tritium accountancy experiments with FLiBe, and applying lessons-learned to the design and execution of larger experiments (100 to 700 L), where the neutron mean free path through the breeding volume is comparable to reactor blankets and TBR approaches unity.

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