Corrosion Product Sampling in Power Plants under Water/Steam Cycle Conditions

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Sampling of process systems is important in power plants because operating decisions often rely on water chemistry information. Experience has shown that unrepresentative samples can mislead operators and result in poor chemistry control. To obtain representative samples, a properly designed sampling system must take into account many factors such as location of sampling points, material of construction, shape of sampling nozzle, sampling procedures, analytical instruments, etc. Sponsored by the International Association for the Properties of Water and Steam (IAPWS), an international collaboration among the University of New Brunswick, Canada, Alstom, Switzerland, and Dong Energy, Denmark considered such factors in a comprehensive review of sampling techniques in nuclear and fossil power plants. The review includes theoretical and practical aspects, and recommends the best way of obtaining representative samples. One of the discussed aspects is isokinetic sampling, which has been widely employed and recommended as one of the key techniques to ensure representative data. It is evident, however, that even though truly isokinetic sampling has been compromised in many cases, meaningful results can still be obtained. To understand such issues of isokinetic sampling, a Computational Fluid Dynamics (CFD) program is used to assess the collection efficiency for magnetite particles of sampling nozzles under water and steam cycle conditions. The program employs an Eulerian-Eulerian multiphase model in calculations of particle concentrations. Different types of sampling nozzle are considered, although particle deposition and release along sample lines are neglected. The simulations therefore address only the collection efficiency within the nozzle opening. It is shown that any practical sampling nozzle acts as an obstacle that disturbs the flow field and tends to remove the isokinetic condition. For sampling magnetite particles from non-fully-developed flow of steam, where the fluid viscosity is low, the collection efficiency depends strongly on sampling velocity. In fully-developed flow of steam, however, sampling velocity is inconsequential. In liquid systems, sampling velocity has no effect.

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