論 文 の 内 容 の 要 旨

論文題目　AN EXPERIMENTAL STUDY ON THE EFFECT OF MACRO-STRUCTURED SURFACE ON CHF IN DOWNWARD-FACING FLOW BOILING

（下向伝熱面沸騰における表面形状効果の実験的研究）

氏　名　カーン　アブドゥル　レーマン

Current ex-vessel cooling capability during a severe accident may not provide sufficient cooling for future LWRs implementing ex-vessel cooling as an accident management strategy. Additional improvement may be required in the heat transfer from the vessel surface. One method proposed is to apply a structured design on the outer vessel surface, specifically a finned surface design. In order to observe the effect of a finned surface during flow boiling conditions, an experimental study was performed to understand the effect of a pin-fin on the boiling heat transfer from a downward-facing surface.

Experiments were performed at highly subcooled and saturated conditions with separate facilities for each condition. In both cases enhancement and reduction of heat transfer was observed depending on the flow rate conditions. The enhancement in the heat transfer was achieved at relatively high flow rates, whereas reduction in the heat transfer was observed at lower flow rate conditions. From both experiments, it was found that the fin is a capable method of improving the heat transfer from a boiling surface during forced convection conditions. Previously, no data was found to confirm quantitatively the ability of a fin to enhance heat transfer in flow boiling conditions. Only for the subcooled experiments bubble accumulation was found to occur in the wake of the fin. The accumulation was believed to cause greater downstream surface temperatures. Even though the fin was able to enhance the heat transfer in both cases, the enhancement was only observed at favorable conditions. Reduction can also be observed even

with the presence of a fin if the conditions do not favor improving the heat transfer. The presence of the fin itself does not guarantee enhancement in the heat transfer.

From the work performed as part of this thesis, it was found that the fin is an applicable method to improve the heat transfer (and CHF) from a boiling surface. It is believed that such a design can be applied on the outer surface of the RPV to improve CHF during ex-vessel cooling. Further studies are necessary to investigate an optimized finned design for application.

Although an oversimplification, the results from this study may be extrapolated and applied to the submerged lower head section of a BWR under severe accident. If bubble accumulation occurs around the CRGTs in the lower head of a BWR, it may be the cause of high surface temperatures. If bubble accumulation cannot be removed, the occurrence of CHF may eventually cause RPV failure. Therefore, such phenomenon may be considered as a safety issue for the submerged BWR lower head. On the other hand, RPV failure may be prevented if the CRGTs act as fins on the lower head of a submerged BWR.