INFLUENCE OF GEOMETRY ON CHF IN TUBE BUNDLES

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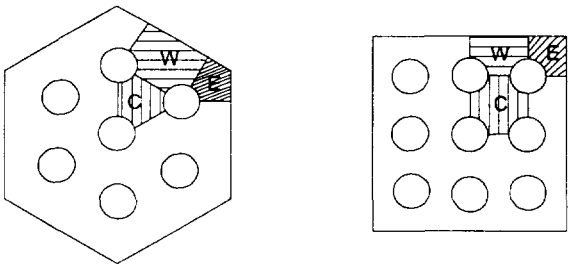
The safe operation of nuclear power plants must begin already at the design stage. In this phase all problems influencing safety should be pointed out and dealt with in the best possible way. Of these Critical Heat Flux (CHF) seems to stay in the centre of interest of scientists in all countries.

The fuel rod bundle can be arranged in various ways. Most popular are rod bundles with a hexagonal or square matrix. Wire wraps, grids and other internal constructions all influence the value of CHF. The problem is in what way all these geometrical factors change the presumed value of CHF.

In this work presented are general parameters describing two-phase flow, the pool boiling process and boiling in channel flow. Next, a general description of CHF is presented with the stress put on boiling in a vertical single tube. This part of the work is based on [1]. Next, presented



(a) (b)

Fig. 1. Example of fuel bundle in:
(a) hexagonal and (b) square geometry;
subchannels: (E) edge, (W) wall (C) central

are some problems in tube bundles, which should be dealt with.

In a fuel bundle it is not possible to exactly foresee the place at which CHF could occur. This means that CHF occurring locally becomes the value for CHF for the whole bundle.

Depending on the type of fuel matrix, the subchannels can vary in shape. In the hexagonal and square matrix it is possible to divide all the subchannels into 3 groups: edge, wall and central. Although they have the same name the shape of the subchannels varies - see Fig. 1. This means that at this point it is necessary to state the exact type of geometry of a subchannel when performing calculations in which subchannel analysis can be used.

One possibility of performing a subchannel analysis would be an extrapolation of the results received for annular geometry. But this even intuitively proves to be not right. There are 3 possible ways of performing a subchannel analysis [2]:

(a) assuming mean values for the whole bundle and assuming that all subchannels are equal;
(b) assuming that all subchannels are different and do not interfere with each other and performing an analysis for each subchannel independently.
(c) performing a relatively exact analysis for each type of subchannels

An exact subchannel analysis raises the problem of interchannel mixing - this means the problem of finding the mass, momentum and energy movements. Also here are various types of mixing possible e.g. diversion crossflow in which the movements are a result of natural pressure differences between the subchannels. In some cases it is possible to introduce new parameters e.g. the mixing coefficient which included in equations could help to evaluate the amount of mass, momentum and energy mixing. Nevertheless a subchannel analysis, in which it is possible to describe the wall, edge and centre subchannels might be worthwhile.

This work is at present at a preliminary phase and is a continuation of [1].

REFERENCES:

[1]. E. Staroń: *Theoretical and Experimental Studies on Critical Heat Flux in Subcooled Boiling and Vertical Flow Geometry*, (in Polish) Raport IAE-24/A, (1996).

[2]. X. Cheng: *Experimentelle Untersuchungen zur kritischen Heizflachenbelastung in 8 mm-Kreisrohren und in 7-Stabbundeln*, KfK 4884, (1991).