



GAS AND FLUID FILM FLOW SIMULATION IN THE CONTACT APPARATUS

I. M. Kuzmenko, R. M. Prokopets
NTUU "Kyiv polytechnical institute"
Peremogy str. 37, 03056 – Ukraine

ABSTRACT

Gas flow and fluid film motion occurs in heat and mass exchange systems, for example, in the regular or irregular packing of cooling and absorption towers. That is why researching it is of practical importance. But the research problem consists in simultaneous and interdependent flow of several processes: fluid film movement, gas flow movement, heat exchange between the film and the flow and mass exchange between the film and the flow. Therefore, its research is complicated. The purpose of the paper is to describe the mathematical models and obtain calculation results of the velocity field when gas flow and fluid film are in motion in the channel of the regular packing of the contact apparatus.

The problem is examined in a vertical cylindrical channel. The fluid film flows down under the gravity force along the internal wall. In the center of the channel there is a forced gas flow. The film thickness is by a factor lower than the channel diameter.

The mathematical model is researched in a cylindrical coordinate system. The model is based on the following assumptions: physical features of the flow and the film are known and constant; there are no turbulent vortexes, a Hagen-Poiseuille flow is built up in the gas.

The mathematical model is described by an equation of the fluid motion under the gravity force, an equation of the gas flow motion affected by differential pressure and an equation of continuity in the gas flow. The last equation makes it possible to determine the flow velocity projections upon the cylinder axis and its radius.

The system of these equations of the mathematical model does not have any analytical solution and has been solved numerically with the following boundary conditions: the fluid film sticks to the channel surface; shear stress forces are equal in the contact area of the flow and the film; the gas flow is axially symmetrical. At the entrance to the channel the gas flow and fluid film velocities are given. The channel geometry and the film thickness are also specified.

The solution of the system of equations has been obtained with the help of MATLAB. The field of velocities in the gas flow and fluid film has been determined in relation to the film thickness, differential pressure and the channel geometry on the assumption of their cocurrent and countercurrent flow motion.

This will make it possible to further calculate heat and mass exchange in the contact apparatus by numerical methods, taking into account the gas flow and film motion.

Keywords: mathematical model, contact apparatus, gas flow, velocity, channel