Preliminary study on flow rate measurement for two-phase flow with two sealed radiation sources

JANGGUEN PARK[1], Sung-Hee Jung[1], Jinho Moon[1]

[1]Radioisotope Research Division, Korea Atomic Energy Research Institute, Republic of Korea

Two-phase flows are commonly used in the industry for the transportation of mixtures, and it is very important to measure their velocity or flow rate for the efficient operation. Various methods for flow-rate measurement have been developed such as the paddle wheel flowmeter, the differential pressure flowmeter, the thermal mass flowmeter, and so on. However, these methods require device installation inside the pipe, and performing these methods for two-phase flow lead to large measurement errors. In this study, flow rate in a two-phase pipe was noninvasively measured with two Cs-137 sealed radiation sources and 3 inch NaI(Tl) gamma detectors using the cross-correlation technique. The data acquisition (DAQ) system was built with the nuclear instrumentation module (NIM) standard which was composed of a high voltage power supplier, an amplifier, and a single channel analyzer, and the signal from the DAQ system was counted by a LabVIEW program. The principle of this flow-rate measurement technique is relatively simple than other techniques, but it is necessary to optimize structures of collimators and shielding materials to meet strict radiation safety regulations and increase measurement accuracy. The water flow was produced in a transparent acrylic pipe, the internal diameter of which is 1 inch, and gas was injected by an air pump. The various configurations for flow-rate measurement system were considered for the optimization preliminary study.