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Radiometric methods in the measurement of particle-laden flows

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1. Introduction

Particle-laden flows with a large number of small solid particles or droplets are fundamental to a great number of environmental and industrial processes, e.g., the formation of clouds, combustion of coal and the catalytic cracking of oil [1-6]. These types of flows also occur in technologies which extract minerals from the sea bed, which are currently in development. A considerable amount of work is focused on the physical phenomena in these types of hydrotransport and experimental studies [7-11].

The current research of two-phase flows applies a variety of contactless measuring methods, such as electrical tomography, X and gamma rays, nuclear magnetic resonance imaging, optical technologies and other methods which are helpful in identifying a number of flow parameters and in the examining of the flow structure [12-22]. Considerable measurement possibilities are offered by radioisotope methods, of which we may distinguish the tracer method and the absorption method. The former consists in the introduction of a radioisotope tracer to the flow and in the tracking of its movement in the measurement section of a pipe. This method may be applied to measure both the parameters of the transport of the continuous phase and the dispersed phase in the two-phase flow. In the case of the flow of the liquid-particle of a solid body, the advantage of this method consists in the possibility of marking and tracing single grains of selected fractions. This method yields precise measurement result, but due to the introduction of an open radioactive isotope to the flow its application requires the adherence to strict safety standards.

On the other hand, the gamma ray absorption method enables the measurement of average velocity and concentration values for the entire population of transported solid particles. The advantage of this method consists in the possibility of application to pipelines which are made of various materials. The pipelines do not have to contain transparent measurement sections, as it is in the case of optical methods. Depending on the

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