change in the amplification rate of the calibrated amplifier 14, and a size of insensibility zone is set so that the signal of controlling on it's output only then appears when the temperature of the semi-finished product rises directly in the time of processing up to 15^0-20^0 C against the surrounding environment temperature. Next, the controlling signal - correction of the knife edge taking thermal expandability of the semi-finished product into consideration, from output of the comparison element 16 is directed to input of the comparison element 18, where it is compared with feedback signal of knife edge location to preliminary converter 19, installed on machine tools base. Differential signal on the output of the comparison element 18, is directed to the input of second power amplifier 20 and next to the electro-hydraulic drive 21.

CONCLUSION

Assuring that abovementioned conditions and the operations order are met (considering also axial deformations stabilization of tool base circuit and correction of the machining depth) the stabilization of stress-deformations depth state of the outer layer can be achieved. This will also allow receiving parts with the demanded accuracy in lengthways and crosswise direction and to keep this accuracy during the exploitation.

References: 1. Драчев О. И. Технология изготовления маложестких осесимметричных деталей. – Санкт-Петербург: Издательство Политехника, 2005. 289 с.
2. Draczow O., Taranenko W. Technologia modułowa wytwarzania osiowosymetrycznych wałów długowymiarowych. . ZESZYTY NAUKOWE Politechniki Rzeszowskiej **nr 230 MECHANIKA, z. 67 -** MODUŁOWE TECHNOLOGIE I KONSTRUKCJE W BUDOWE MASZYN, Rzeszow 2006. –S. 47 – 50. **3.** Taranenko W., Świć A. Technologia kształtowania części maszyn o małej sztywności. Wydawnictwo Politechniki Lubelskiej, Lublin, 2005. – 282 s. **4.** Taranenko W., Świć A. Urządzenia sterujące dokładnością obróbki części maszyn o małej sztywności. Wydawnictwo Politechniki Lubelskiej, Lublin, 2005. – 186 s. **5.** Ящерицын П. И., Скорыпин Ю. В. Технологическая и эксплуатационная наследственность и ее влияние на долговечность машины. – Минск: Наука и техника, 1978. – 119 с. **6.** Рыжов Э. В., Суслов А. Г., Федоров В. П. Технологическое обеспечение эксплуатационных свойств деталей машин. – М.: Машиностроение, 1979. – 176 с.

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COMPARISON OF CUT OUT'S INFLUENCE ON THE HYDRODYNAMICS OF THE TWO-PHASE GAS-LIQUID FLOW IN HEAT EXCHANGER WITH SEGMENTALL BAFFLES*

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This paper presents DPIV techniques, applied for evaluation of hydrodynamic properties of two-phase gas-liquid flow. The process of the flow were performed in shell side of heat exchanger. Single image of the two-phase flow registered by digital video camera in grey scale reflects instantaneous concentration distribution of particular phases. The idea of proposed method of gray level fluctuations analysis is based on determination of the change of certain features which are results of digital image representation (that is image as a distribution function of gray level values).

Introduction

Geometrical parameters of baffleless exchanger include the quantities describing tube insert: the arrangement of tubes, external diameters of tubes, tube spacing, number of tubes. For an exchanger including segmental baffles the additional geometrical parameter could include: number of baffles, opening window in baffle, distance between baffles, etc. An important role is attributed to clearance originating from the necessity of mounting baffles, whose shapes vary throughout exploitation. Clearances include leaks between the shell and baffles and leaks between openings in baffles and tubes [1].

Baffles are primarily used in shell and tube heat exchangers for including cross flow over the tubes, and as a result, improving heat transfer performance. Taborek suggests that the distance between the baffles could vary in the range of a minimum of 20% of shell diameter and a maximum of the shell diameter [2].

Experimental setup

The process of two phase flow has been realized in test channel (1220/240/30mm) with 30% cut out and distance between two baffles – 180mm. In this paper two different geometry configurations are presented. The parameter, which is analyzed in this part of investigation is relative pitch. As a visual inspection method was applied, the channel was made of plexiglass and the continued phase-water was tinted with methylene blue. Images were recorded using fast CMOS camera with the frequency of 1024 x 1024 pixels. They were subsequently saved in the memory of a recording device and the sequence of images was recorded on a computer hard disk.

The sequence of images recorded in this way involves 512 images processed for data analysis with the aid of a PCs., including double-processor machines.

The lighting was provided from two 1000 W reflectors each connected to a control console. In order to record the flow the camera was mounted on a specially designed tripod and recorded images from above.The grey level value of the obtained recordings from gas-liquid flow was the basic parameter for process investigation. Based on this parameter it was possible to calculate and determine many important characteristics of two phase gas-liquid flow.

Methodology

The main conception of experimental investigation was based on two assumptions:

- grey level value make classification of two-phase flow structures possible
- knowledge about velocity distribution and two-phase flow mixture movement trajectory allow to determine silent and circulation zones

In order to determine flow structures, stochastic function- probability density function was used. Skewness coefficient is one of the stochastic parameters which give information about character of probability density function.

For the calculation of vector field DPIV software was applied (Bieńkowski [3]).

Results analysis

Particle Image Velocimetry has been recently developed for flow measurements in a wide region of flow field. Thanks to computer analyses flow structures can be determine with large precision physical interference. Digital Particle Image Velocimetry (DPIV), used in this

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paper, bases on the principle of correlation following frames of the recorded flow sequence. In two phase flow for velocity fields calculation air bubbles were treated as tracer particles and their velocity was calculated [4].

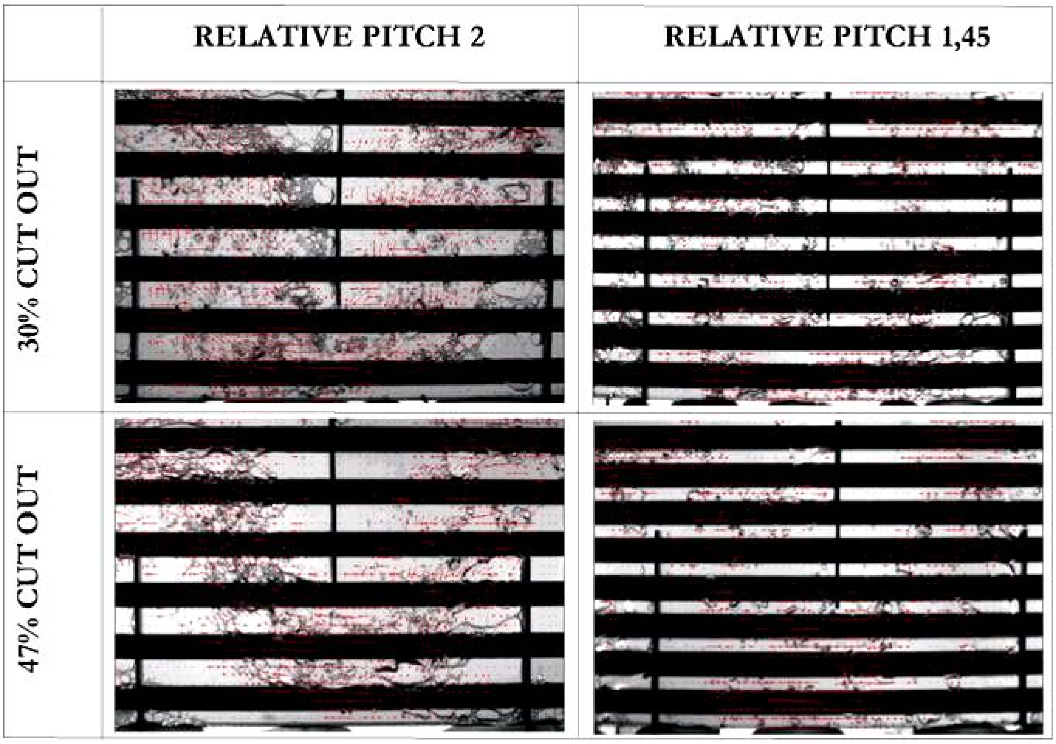

Fig.1. Exemplary velocity vectors for the two-phase flow in the channel with five baffles and 30% cut out with two different relative pitches

Gas velocity in different zones was measured using DPIV technique with optical flow algorithm. The results of these measurements are presented on figure 1.

Another parameter, which was used during experimental investigation was skewness coefficient. Skewness tell us about the symmetry of the distribution. When the distribution has a greater tendency to tail to the right, it is said to have positive skewness. When the distribution has a greater tendency to tail to the left, it is said to have negative skewness. For the normal distribution (as well as for any other symmetrical distribution), the skewness coefficient equals 0.

For bigger relative pitch (t/d=2) skewness coefficient vary between -2 to 2 and for t/d=1,45 range from -3 to 0,5. For smaller relative pitch in more measuring points, than for bigger pitch normal distribution, was observed. For the bigger relative pitch by increasing the relative velocity for gas and liquid, skewness coefficient value increase and distribution has left skewness character.

The relative velocity for gas and liquid, which was used to determine skewness coefficient was calculated as quotient of stream flow and cross-section.

In figure 3 skewness coefficient distribution in three-dimensional configuration for bigger relative pitch (t/d=2) is presented.

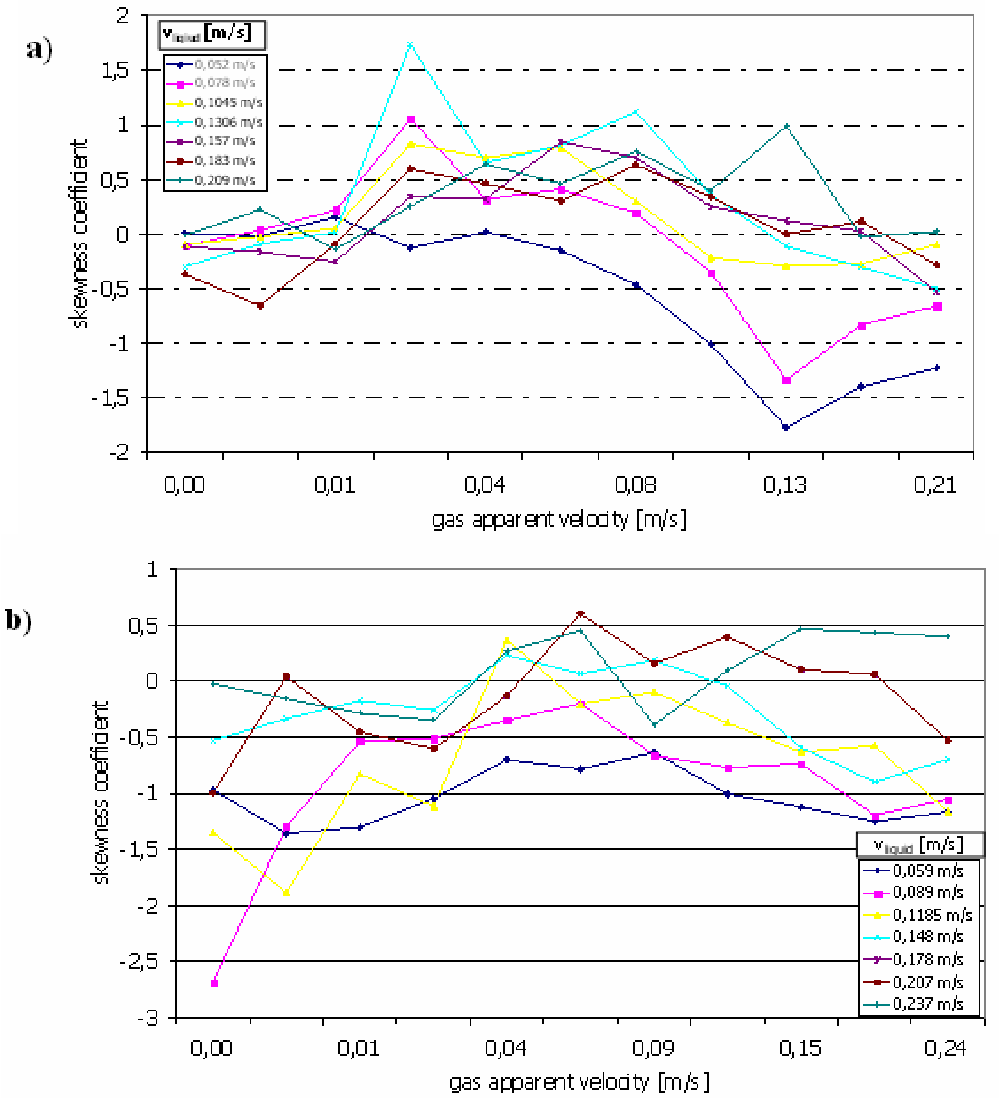

Fig.2. Distribution of skewness coefficient: a) t/d = 2; b) t/d=1,45

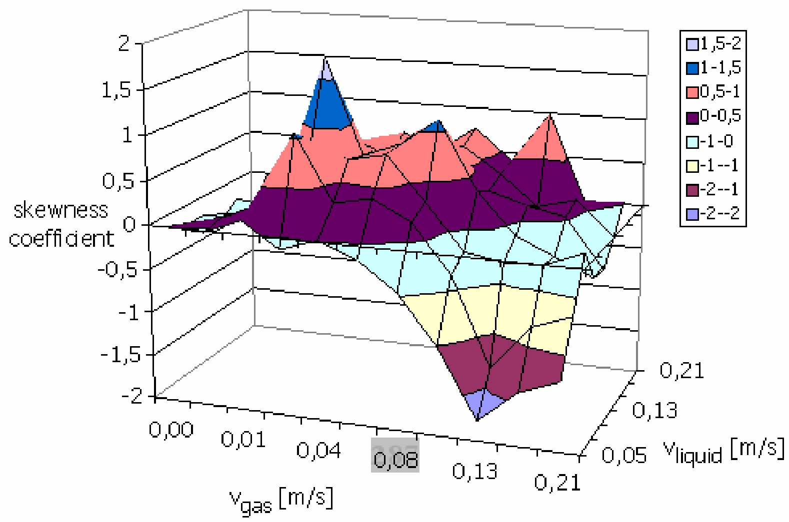

Fig.3. Skewness coefficient distribution in three-dimensional configuration.

Conclusions

It was observed, that quantity of relative pitch has influence on the skewness coefficient value and for smaller relative pitch skewness has normal distribution in larger range of gas apparent velocity, than for bigger.

On the basis of the realized experimental investigation, it was found that DPIV techniques are effective and advanced implement helping in hydrodynamics flow evaluation.

It was observed too that, geometry configuration has influence on the two-phase gas-liquid flow in tube bundle space of heat exchanger.

References: 1. Skoczylas D., Influence of parameters on pressure drop for flow in tube bundle of shell-and-tube heat exchangers, Ph. D. Thesis, OUT, Opole. 2. Taborek J.: Shell and tube heat exchangers: single phase flow. In Heat Exchanger Design Handbook, Section 3.3 Hemisphere, New York (1982). 3. Bieńkowski G.: Zastosowanie cyfrowej anemometrii obrazowej do wyznaczania pol prędkości, MSc Thesis, Politechnika Warszawska, Płock 1999. 4. Iwaki C., Cheong K.H., Monji H., Matsui G.: PIV measurement of the verticalcross – flow structure over tube bundles. Experiments in Fluids 37, pp. 350 – 363, 2004.

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HYDRODYNAMICS OF PHENOMENA IN CO – CURRENT AND COUNTER – CURRENT TWO – PHASE GAS – LIQUID FLOW IN VERTICAL CHANNEL*

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In this article is presented the possibility to determine the limit between performing of co - current and counter – current two-phase gas - liquid flow in vertical channel as well as comparing of structures forming in both cases of the flow at applying methods utilizing levels of grey of registered images for recognizing of the image.

Introduction

Multiphase flows are important issue performing both in the nature and in the processing technology. The particular important area of multiphase flow in the two – phase gas – liquid flow in channels. It is occurring in very many disciplines of the technology, e.g.: in barbotage columns, at stirring or dividing of the gas and liquid, in evaporator multilayer apparatuses, in oil pipelines, in processes of the altered version of the crude oil, at evaporating and condensation in energy, chemical and cooling devices.

Two-phase gas – liquid flow can be realized both in horizontal and vertical channels. In vertical channels three cases are possible in terms of the direction of flow of both phases (liquid and gas):

- parallel current – gas and liquid flow upwards,

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