

UDC 532.526

S.V. Kopylov

National Aviation University, Kiev

EXPERIMENTAL STUDY OF THE PRODUCTION OF AIRCRAFT PLASTIC PIPES USING MODERN LASER TECHNOLOGY

The article presents the results of the study of production of plastic pipes. Such pipelines are used in modern military aircraft. Such research is challenging. The difficulty lies in the precise determination of shearing stresses in the production of such pipelines. Shear stresses affect the destruction of the pipelines during their operation.

Keywords: Liquids, pipelines, Laser.

Introduction

Problem definition. In article features of physical modeling and measurement kinematics and dynamics characteristics of a current of stream non-Newtonian liquids in a backlash between cylindrical surfaces are described. At processing production of aviation polymeric pipelines of determination of kinematics and dynamic descriptions of technological processes and deformation descriptions of fusions are got as experimentally so in theory have a large practical value.

Analysis of recent researches and publications. To research of flow of non-Newtonian liquids in a double pipes area the de-voted row of researches in particular Leybenzon, Mak-Kelvi of Fridrikson and Bird et al. If for non-Newtonian liquids flow in two-bin an area full enough studied, for non-Newtonian liquids analytical decisions carry more frequent close character. In the resulted researches absent information is about influence of terms of entrance on the parameters of stream in the area of initial area about distributing of speeds into account the difference of area of surface of external and internal pipe separate in-formation about length of initial area which results in leading to of .

The formulation of the problem of article. The problem is the definition of a plot of velocities with high accuracy. High accuracy is needed to determine shear stresses with high accuracy.

The main material

The feature of such equipment is that the workings areas of such equipment are short and flows there not stability according to a flow on a hydrodynamic initial area. For the calculation of equipment it is necessary to know kinematics and dynamic descriptions of stream, and also sliding which arises up. For example, kinematics and dynamic descriptions are needed for timing stay of polymer in a working area, to shut out his overheat and in some cases of burning which can result in the break of pipe during exploitation of air ship. It is also necessary to know the tangents of tension, exceeding of which conduces to large superficial heterogeneity,

which results in the greater vibrations of stream, which in same queue leads to that polymer it goes out as the involutes stream which also results in large superficial heterogeneity distorted, which result in the pulsations of stream which also can result in the break of pipe during exploitation of air ship. If for a non-Newtonian liquid these tasks are decided, for the non-Newtonian liquid of decision carry close character, absent or incomplete information about length of hydrodynamic initial area distributing of pressure and tangents of tangents of tension. In this time, for that, to start a machine in series it is necessary to make a model to conduct a physical design and only after this equipment started in a mass production that result in the high cost of products. In actual work the physical design of flow of non-Newtonian liquid was conducted in a between too pipes area. A mathematical design was before done it was based on the decision of the system of equalizations of boundary layer which takes into account practically everything really possible variety of terms of entrance of stream in a channel at next maximum and initial terms. This system is universal. The chart of decision was specified at an analytical decision. The physical design of flow was conducted on the specially collected stand which researches of kinematics were simultaneously conducted on, dynamic and rheological descriptions of stream of non-Newtonian liquid at its flow in a between too pipes area. As designing liquids were used aquatic solutions of PVS of brand 72 GOST 10779-69 and by part of sodium salt and KMC THAT 15-692-72. As designing liquids were used aquatic solutions of PVS of brand 72 GOST 10779-69 and by part of sodium salt and KMC THAT 15-692-72. Choice them based on that them rheological properties are such, as well as at fusions of polymers. The concentrations of races of work in connection with the wide range of the set indexes of flow hesitated from 0,5 to 1,5. Liquids long enough kept the structure and did not appear inflammable and toxic. The range of serves had an experimental stand from that answers speeds of change from 0,32 – 192 s⁻¹. Hydraulic part of stand is executed as reserved a contour and

consisted of centrifugal the pump of "Calpeda" MGH with vector CU HITACHI Sg-200 and reverse connection on pressure and ventilator for cooling of electric motor of working area calming and down low a tank and flowing a tank and induction flow meter of RKE-29. The use of scalar CU to the pump appeared impossible in connection with that scalar CU does not provide a high circulating moment which necessary for the pumping-over of polymers. Use flowing a tank it is necessary for doing of pulsations of stream impossible which arise up in connection the features of non-Newtonian conduct of liquid. Vector CU HITACHI Sg-200 tailed to PC for the change of fixing and control of parameters of electric motor of pump and ventilator. A working area is executed as glass twin-tubes of different diameter with the thickness of wall 0,5 mm and long a 1,5 meter. Distributing of pressure was measured by gauges. Rheological of description was measured on the viscometer-stirrer of "Reotest 2". Kinematics descriptions were measured on the specially collected laser Doppler measuring device [2] of speed on the basis of differential chart theoretical development of which resulted in . However much the use of such chart in practice for research of non-Newtonian liquid appeared not impossible. Therefore such chart was done and complemented. A chart consisted of helium – neon emitter of LG-79-1, which generates a ray, 0.63 mkm with the index of TEM (0, 0) by power to 24 mW. Power of laser radiation was regulated by CU. A ray from an emitter go on light divisible block, where divided into two rays for 50 percents of power. These two rays by specially constructed for such researches of lenses with a candle-power 1.2 and 50 mm. and 15 mm. focused focal distance in the probed point of stream of liquid. Two lens was used for that, to measure local speed in the wide range of speeds in connection with that frequency of signal depends on a corner under which rays intersect and at the exceeded frequencies of signal higher 100 kHz frequency of signal will be is in the area of noises of radio frequencies and noises from a laser radiation in connection with the considerable not focusing of laser rays after their crossing in the stream of non-Newtonian liquid. As noises of radio frequencies on amplitude higher, than amplitude of signal it would be impossible to measure a signal. To use a lens for focusing of rays at the liquid probed a point at measuring of epure of speeds in between pipe space it appeared impossible in connection with extraordinarily large aberration of rays on the edges of lens which increased due to heterogeneities which are present on-the-spot be what pipe and lens effect of pipe that led that the closeness of power of laser radiation in the point of measuring diminished so that measuring of epure of speeds appeared impossible. On that reason the use of prism appeared impossible for unlinking of laser ray. For diminishing of influence of surface of pipes on

aberration in this work pipes were used with the thickness of wall 0,5 mm. In a lens which was created specially for such researches corrected aberration and the form of ray changed thus, that a cut of ray in the point of measuring was cylinder and also for doing of origin of effects of non-Newtonian optics impossible. A lens consisted of six lenses. As known every lens removes 5 percents of laser radiation. That the losses of power of laser radiation were made by the more than half of power that would bring a lead through over of experience to impossibility. In connection with foregoing it was done coverage on every lens which consisted of 16 layers. Such coverage allowed to decrease the losses of radiation which in all chart made not more than 3 percents. There was interference at crossing of rays. When parts which were in a liquid passed through this point from them a signal, proportional speed of part, was reflected. This signal through a lens with focal distance 50 mm and by a candle-power 1.4 focused on a diaphragm with the diameter of opening $2 \cdot 10^{-6}$ mm. Diaphragm opening determined size an experimental way. Diaphragm was used for that in order to avoid the hit of superfluous laser radiation and other light in photo electronic for a multiplier so as such light has amplitude higher, than amplitude of signal and frequency the same as frequency of signal. For the increase of exactness measuring was conducted diaphragm of laser rays in a lens. Diaphragm it is in this case necessary for that, to increase the depth sharpness's of image of intersection laser rays and avoid influence on measuring of local speed of nearby layers of liquid. Farther a signal was caught photo multiplier. In which on electrodes a signal increased and there was the first transformation of Fourier. The place of location of photo multiplier got out on the basis of research of diagram of dispersion pseudo plastic liquid which investigational the author of the article first in-process. After a photo multiplier signal go on a switch, then on the specially developed rejecter filter, for that, to select necessary frequency and then on a selective strengthener. The use of ordinary filters for such researches appeared impossible because as known every radio signal consists of spectrum of signals which have different frequency. Each of signals of this spectrum is responsible for the form of signal. The constituents of spectrum of signals at such researches coincide on frequency with frequency of noise. That ordinary filtration of signal resulted in filtration and constituents of spectrum of signal that and signal. It brought a lead through over of such experiments to impossibility. For development of filter for such researches it is necessary it was to consider every constituent of spectrum of signal. The lead through of such researches became possible at the use digital spectrum of analyzer in which the foreseen function of memorizing of all constituents of spectrum of signal. As known amplitude of spectrum

constituents sharply diminishes at the changed frequencies from bearing to endlessness.

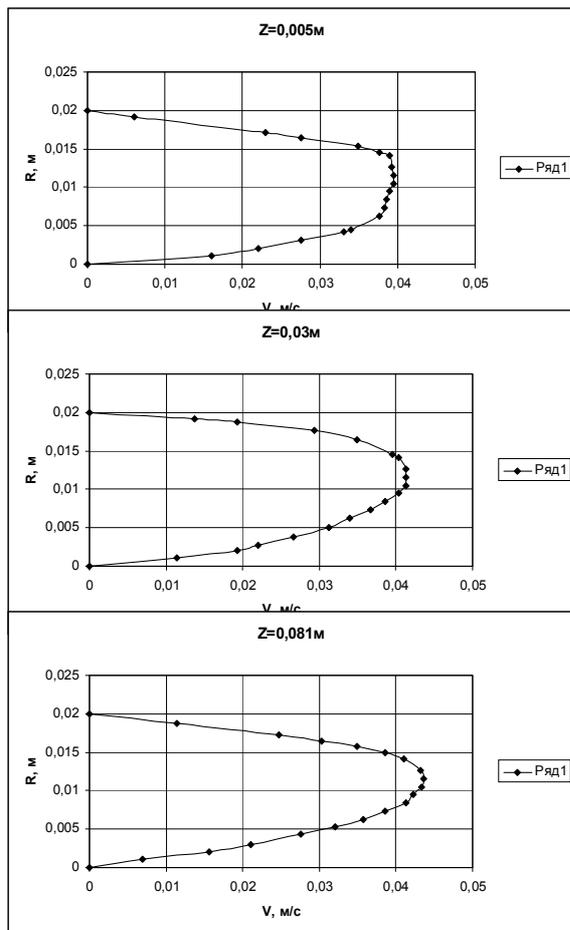


Fig. 1. Local speeds

Therefore on this go there was the developed filter which simultaneously conducted filtration on amplitude and frequency of signal with such calculation, to skip fully bearing frequency and spectrum constituents and to filter noise only. Development of filters became

complicated yet and those that frequency of signal changed depending on speed of particles. In accordance with it changed frequency and all constituents of spectrum of signal. Therefore filter members are neat thus, that fix changes of frequency of signal and his constituents of spectrum and accordingly to filter noise only. After a selective strengthener a signal was given on the digital of "Rigol". From "Rigol" an on a processor for that, to support the necessary level of signal when particles are not in the area of crossing of laser rays and then on the analyzer of spectrum of "Agilent". On the analyzer of spectrum measuring of frequency of signal was conducted. From the analyzer of spectrum a signal is given on PC where registered and due to the developed software transferred in speed and the plot of speeds is built.

Conclusion

The results of experimental researches were confronted with analytical, that allowed to draw conclusion about convergence of results experimental and analytical. An error makes no more one percent. As a result of work the made method of calculation of technological equipment. On the basis of method the created program of calculation is on PC.

The results of researches were inculcated on the row of enterprises of Ukraine.

References

1. Ринкевичюс Б.С. Лазерная диагностика потоков / Б.С. Ринкевичюс. – М.: МЭИ. 1990. – 287 с.
2. Ринкевичюс Б.С. Лазерная анемометрия потоков / Б.С. Ринкевичюс. – М.: Энергия, 1978. – 160 с.

Надійшла до редколегії 16.04.2015

Рецензент: д-р техн. наук, проф. С.О. Іщенко, Національний авіаційний університет, Київ.

ТЕОРЕТИЧНЕ ДОСЛІДЖЕННЯ ВИРОБНИЦТВА АВІАЦІЙНИХ ПОЛІМЕРНИХ ТРУБОПРОВОДІВ

С.В. Копилов

У статті представлені результати дослідження виробництва полімерних трубопроводів. Такі трубопроводи використовуються в сучасних військових літаках. Такого роду дослідження є складним завданням. Складність полягає в точному визначенні дотичних напружень у виробництві таких трубопроводів оскільки дотичні напруження впливають на руйнування трубопроводів в процесі їх експлуатації.

Ключові слова: рідини, трубопроводи, лазер.

ТЕОРЕТИЧЕСКОЕ ИЗУЧЕНИЕ ПРОИЗВОДСТВА АВИАЦИОННЫХ ПОЛИМЕРНЫХ ТРУБОПРОВОДОВ

С.В. Копылов

В статье Копылов представлены результаты исследования производства пластиковых труб. Такие трубопроводы используются в современных военных самолетах. Таких исследований является сложной задачей. Сложность заключается в точном определении касательных напряжений в производстве таких трубопроводов так как касательные напряжения влияют на разрушение трубопроводов в процессе их эксплуатации.

Ключевые слова: жидкости, трубопроводы, лазер.