COMPUTER MODELLING OF MOVEMENT OF MEAT RAW MATERIAL ON PIPELINES

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REZUMAT. În lucrarea de faţă s-au analizat metodele pentru determinarea parametrilor de proiectare a sistemului de conducte pentru transportul pneumatic, care utilizează sisteme moderne de calcul pentru analize inginereşti. Pentru determinarea parametrilor geometrici şi de putere ai echipamentelor tehnologice este propusă abordarea integrată. Pe baza modelului anterior tridimensional al conductei este propus un mediu CAD pentru a simula mişcarea în domeniile de produse diferite. Utilizarea simulărilor pe baza acestor metode de calcul tradiţionale măreşte exactitatea rezultatelor. Simulările au fost făcute în mai multe variante pentru raza roţii, de la 80 mm la 250 mm cu o schimbare de pas. Drept rezultat al simulării sunt definite nivelele de presiune. Cu ajutorul lor putem determina puterea unității compresor.

Cuvinte cheie: modelare,simulare, conductă, transport pneumatic.

ABSTRACT. In the present work has examined methods for determining design parameters of the pipe system for pneumatic transport using modern computer systems for engineering analysis. Integrated approach is proposed for determining the geometrical and strength parameters of the technological equipment. On the basis of previously established three-dimensional model of the pipeline it is proposed an environment of CAD system to simulate the movement in different product areas. Using simulations based on these traditional methods for calculation allows to increase the accuracy of results. Simulations were made in several of the wheel radius, from 80 mm to 250 mm with a step change. As a result of the simulations are defined levels of pressure. With their help we can determine the power of the compressor drive.

Keywords: modeling, simulation, pipeline, pneumatic transport

1. INTRODUCTION

Depending on the location of production plants and other facilities of undertakings for the processing of meat commodities supplied through the production pipeline positions, down, pneumo-transport, in cars, elevators and conveyors hanging.

Transportation of raw materials involves considerable difficulties. Problems are particularly acute for processing materials with different sizes (from individual organs to whole carcasses) have different mechanical, physical and chemical properties [1, 3, 4]. The choice of mode of transport of raw materials is significantly affected by the floors of industrial buildings.

In an article we will discuss techniques to search for design data pipeline tank pneumatic transportation of raw materials. Carts used to transport by pipe length of pre-ground meat products. They are devices with periodic action. They can also be used for transportation of liquid products and pieces that can not be transported from the pump. It is possible that these products are pumped into the mixture with water (part of the water can reach 50%). The duration of transport of raw materials without charge lasts up to 3 minutes and depends on air pressure, the compressor performance, length and configuration of transport line.

When designing the plants processing meat to perform a calculation is the basis for efficient and reliable operation and durability of the equipment [2]. It is therefore proposed to use a comprehensive approach for determining the geometrical and power parameters of equipment.

2. SUMMARY

Available first to create three-dimensional model of the pipeline in an environment of CAD system. Then make a simulation of the movement of a product in different locations of the pipeline. Further, the use of traditional procedures for design will allow achieving increased accuracy of results. During the simulation of the movement of a product

line under the action of increased pressure of the air explore such processes as:

- Effect of pressure difference in the process of transportation;
- Effect of change of velocity of movement of raw materials for transportation;
- Effect of change in radius of the wheel of the pipeline on the movement of product.

To study the processes in the transportation of raw meat is used in piping system FlowVision. The model of the pipeline is designed in advance and paid into the system FlowVision.

Program complex FlowVision is intended for modelling three-dimensional streams of a liquid and gas in various objects and representations of results of work by methods computer schedules. Modelled streams include stationary and non-stationary, compressed, poorly compressed and incompressible streams of a liquid and gas. He is based on a certainly-volumetric method of the decision of the equations of hydrodynamics and uses a rectangular adaptive grid with local crushing. Use of various models of turbulence allows to model complex movements of a liquid, including streams with a strong twisting, streams with a free surface.

To determine the parameters of the process of transporting the material through a pipeline program FlowVision complex used a mathematical model of the "incompressible fluid". This model is designed for modeling of flows with large Reynolds numbers – turbulent and small changes in density. In the mathematical model includes the equation of the Navier-Stokes equation for the conservation of energy equation and the transfer of mixtures taking into account the diffusion and convection.

To model the movement of raw meat in the pipeline was developed prior to the piping system

model, which is submitted to complex programming Flow Vision. The pipeline is divided into separate objects (Figure 1) for more accurate calculations and modeling. Discusses three main sections - horizontal, vertical, and knees.

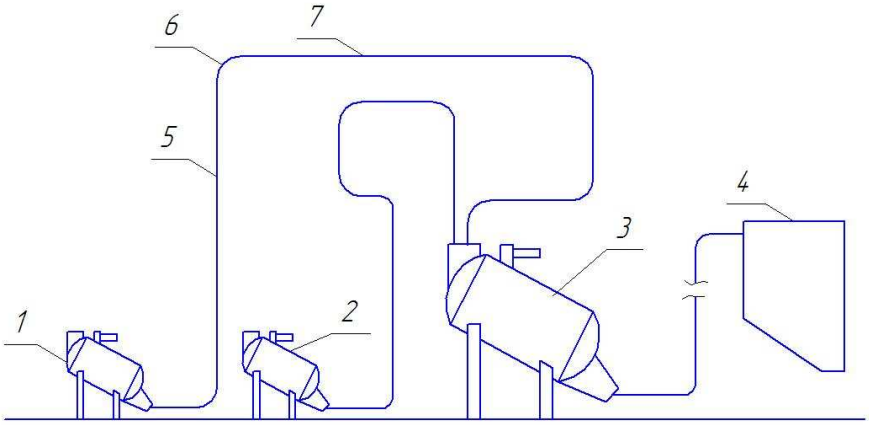


Fig.1. *The typical scheme of pneumatic transport:*
1, 2 - industrial tanks, 3 - store tank, 4 - reception bunker, 5 - vertical site, 6 - turn, 7 - horizontal site

The used methodology in the design allows to obtain specific values of the parameters of motion for each segment. Numerical values of the output of the previous section define input values for the next. Also defined rheological characteristics of raw meat: viscosity and density.

In Fig. 2 presents graphs of pressure variation in the length of the pipeline. Computer modeling allows to accurately determine their numerical values as the program takes into account the roughness of the pipe and rheological characteristics of the transported product.

In Fig. 3 depicts a graph of change of velocity ofthe product in its movement along the pipeline. Withtheir help we can determine the real pipes decelerationin linear plots and to determine the nature of this amendment.

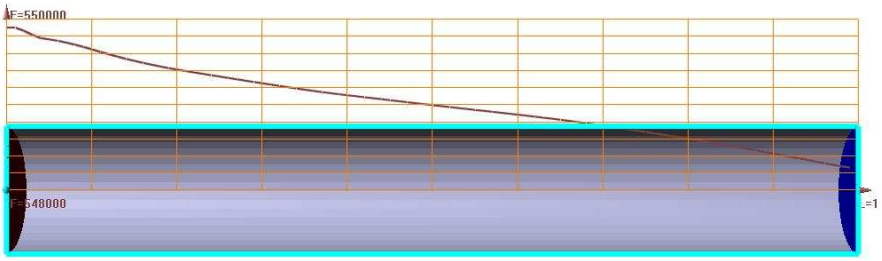


Fig.2. *Typical pictures of change of pressure at movement of a product on pipelines of various length*

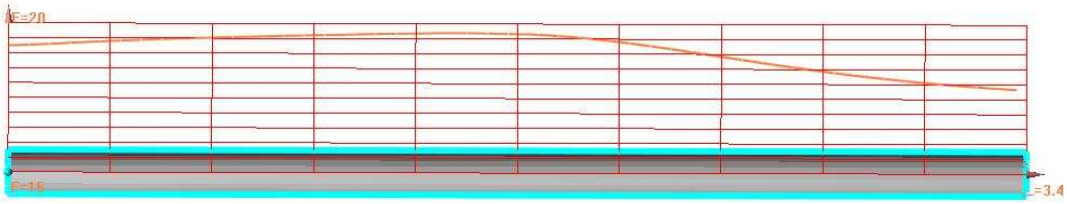


Fig. 3. *The graph of change of speed of movement of a product along the pipeline*

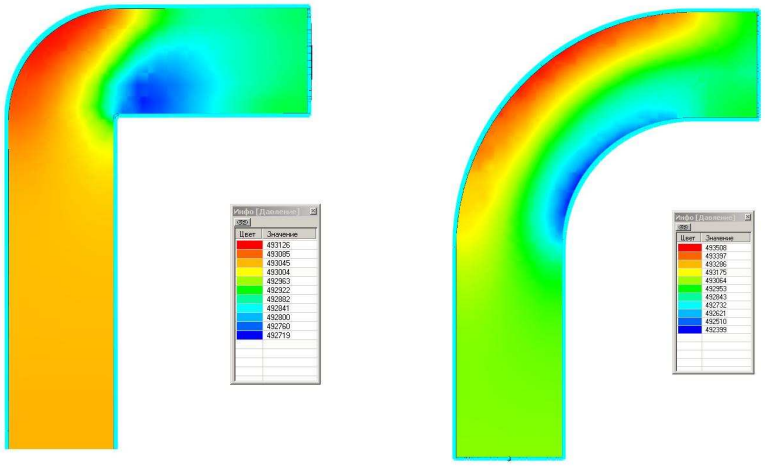
Study the influence of the radius of curvature of the pipeline in the knees is to model the process of transporting the product in environments with varying curvature. This study is necessary because the design of the piping system must be taken of the building geometry and characteristics of the pipeline necessary to ensure the movement of product.

For the survey were selected several radii of curvature. The minimum is 80 mm, and maximum 250 mm. The change in radius is a certain step.

In Fig. 4 presents the graph of distribution of pressure in borderline cases. The change of color shows how to distribute the pressure inside the pipeline when the radius of curvature change.

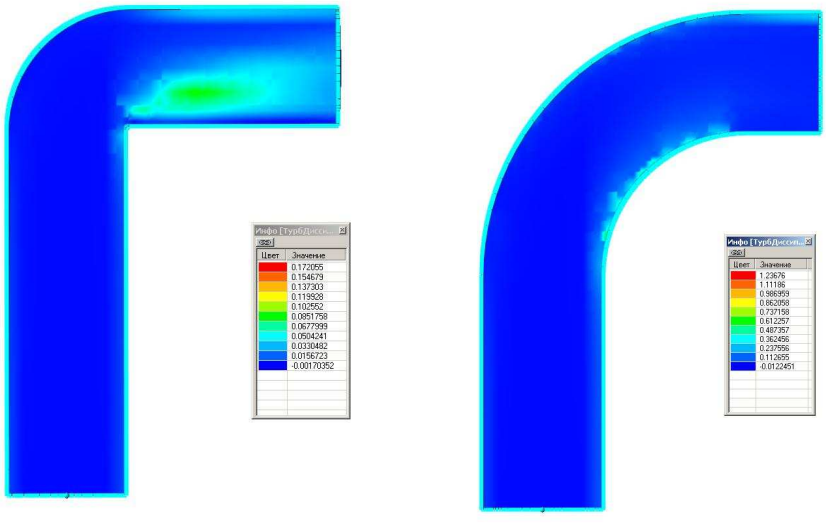
Analysis of these images makes it possible to draw conclusions about the influence of the radius of curvature of the knees on the occurrence of dead zones, grounding products and the formation of plugs.

Also studied the influence of the radius of curvature on the dissipation processes in the product: the possibility of vortices, which lead to a reduction in speed and additional power consumption.



a) b)

Fig. 4. *Distribution of pressure at movement of a product through pipelines with various radius of turn: a - 80 mm, b - 250 mm*

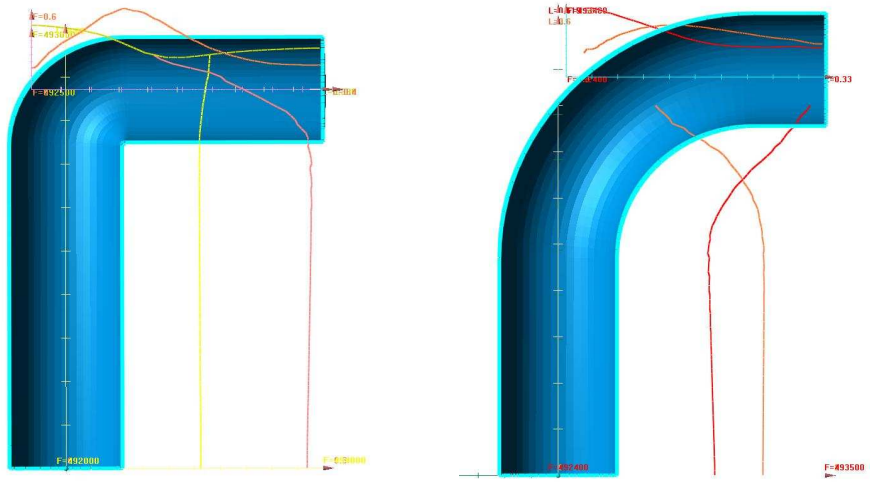


a) b)

Fig. 5. *Parameters turbulent dissipation at movement of a product through pipelines with various radius of turn: a - 80 mm, b - 250 mm*

On the graph shows the locations of occurrence of vortices, which affect the total energy of the process of transportation.

Computer modeling allows to determine numerical values of fall velocity and pressure in different parts of the knee.



a) b)

Fig. 6. *Schedules of change of speeds and pressure before turn of a pipe at movement of a product through pipelines with various radius of turn: a - 80 mm, b - 250 mm*

After completion of the computer modeling data are used to determine the structural parameters of the pipeline.

Determine the required total pressure of the pipeline.

It reported:

- Air pressure at the outlet of production;
- Initial air pressure required to drive the product;
- The air pressure required for recovery of the product height difference;
- The air pressure needed to accelerate the product;
- Shear stress in which the product begins to move;
- Loss of pressure to overcome the friction of the product on the walls of the pipeline.

The resulting pressure values used for determining the capacity of the compressor drive.

3. CONCLUSIONS

The article demonstrated the capabilities of modern computer systems for modeling objects in the food industry, simulation of processes occurring in them, the performance of engineering analysis and based on the results of the design process equipment with high performance indicators.

Proposed a comprehensive approach in which pre-determine optimum process parameters and design of machines and equipment. The example is based on processes in pneumatic conveying equipment.

Using computer modeling allows the determination of parameters of pneumatic conveying equipment to greatly improve accuracy.

This leads to improving the quality of the design work and creation of high technology and reliable equipment in the food industry.

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