

ISSN 2181-8622

Manufacturing technology problems



Scientific and Technical Journal Namangan Institute of Engineering and Technology

INDEX  COPERNICUS
I N T E R N A T I O N A L

**Volume 9
Issue 4
2024**



UDC 621.565.93/95

INFLUENCE OF SURFACE LAYER THICKNESS ON HYDRAULIC RESISTANCE OF THE DEVICE

ISMAILOV MIRZAAKBAR

Assistant of Namangan Institute of Engineering and Technology, Namangan, Uzbekistan
Phone.: (0894) 175-5705, E-mail.: imirzaakbar@gmail.com

Abstract: The increase in the thickness of the scale on the inner surfaces of technological pipes reduces the cross-sectional area of the pipe, thereby decreasing its conductivity. As a result, the coefficient of friction in the pipe increases, which in turn leads to an increase in its hydraulic resistance. This causes a sharp increase in the amount of energy consumed, as the required pump power for fluid transportation rises accordingly.

The main objective of determining the hydraulic resistance of flowing fluids in heat exchange systems through experimental or calculation methods is to identify the power required to drive the flow. Hydraulic resistance mainly depends on factors such as flow velocity, its physical properties, the pipe's structural parameters, and the accumulated mass of the scale within the pipe.

The comparative analysis of the pressure loss ΔP values of the heated water moving through the inner pipe of the shell-and-tube heat exchanger was carried out through calculations.

Keywords: heat exchange, hydraulic resistance, pressure, local resistance, scale mass.

Introduction. The primary objective of determining the hydraulic resistance of flowing fluids in heat exchange systems through experimental or computational methods is to identify the power required to drive the flow. Hydraulic resistance mainly depends on factors such as flow velocity and its physical properties, the pipe's structural parameters, and the accumulated scale mass within the pipe [1-4]. The comparative analysis of pressure loss ΔP values for heated water moving through the inner pipe of the shell-and-tube heat exchanger was carried out through calculations [4-8].

The total loss of pressure ΔP_{gen} in the flow within the inner pipe of the heat exchanger is formed by the pressure loss due to friction (ΔP_{fr}) and the pressure loss due to local resistances in the pipe ($\Delta P_{local\ res}$) [1, 6-11]:

$$\Delta P_{gen} = \Delta P_{fr} + \Delta P_{local\ res} \quad (1)$$

The pressure loss due to friction ΔP_{fr} is dependent on the viscosity of the hydrocarbon feedstock moving through the pipe [1, 10-12]:

$$\Delta P_{fr} = \lambda (v^2 \rho / 2) (L_{gen} / d_i), \quad (2)$$

where: λ - is the friction coefficient, v -is the flow velocity, m/s, ρ -is the density of the material, kg/m³, L_{gen} - is the length of the heat exchange pipe, d_i -is the internal diameter of the pipe, m.

The pressure loss due to local resistances $\Delta P_{local\ res}$ is calculated using the following formula [1, 13-30]:

$$\Delta P_{local\ res} = \sum_{i=1}^n \xi_i \rho v^2 / 2. \quad (3)$$

Methods. The values of the local resistance coefficients ξ_i , in heat exchange systems are provided in the literature. In shell-and-tube heat exchangers, the following local resistance coefficients are typically used: For a low-corrosion welded steel pipe with

smooth joints, the resistance coefficient is - $\xi_1=0.2$; (For entry into a sharp-edged pipe, the resistance coefficient is - $\xi_1=0.5$), For exit from a sharp-edged pipe, the resistance coefficient is $\xi_2=1.0$; For sudden expansion of flow, the resistance coefficient is $\xi_1=0.5$; For sudden contraction of flow, the resistance coefficient is $\xi_1=0.35$ [1].

Results. According to the company regulations, a two-way heat exchange system is installed for the cationic filtration line of the water. The main parameters of the system are provided in table1

Table 1. Operating parameters of the heat exchanger

N _o	Indicators	Unit of measurement	Size
1	The diameter of the outer pipe, D_{ext} .	mm	420
2	Inner pipe length, L	mm	3000
3	Total number of pipes, n	grain	122
4	Number of roads, z	grain	2
5	The temperature of the water at the entrance to the device, t_1	°C	20
6	The temperature of the water at the outlet of the device, t_2	°C	80
7	The temperature of the steam at the entrance to the device, t_3	°C	150
8	The temperature of the steam at the inlet from the device, t_4	°C	121
9	Water pressure at the inlet to the device	kPa	250
10	Steam pressure at the inlet to the device	kPa	600

From the experiments conducted on the heat exchanger, it was found that during the movement of water in the internal pipe of the device, the outer mass accumulates. As a result, the cross-sectional area of the pipe decreases. This leads to a sharp decrease in the throughput of the pipe and, at the same time, an increase in the amount of energy spent on driving the flow.

Table 2 shows the change in the hydraulic resistance in the internal pipe of the heat exchanger used in the preparation of water for technological processes at “Uchkurgan-Yog” JSC, depending on the thickness of the outer layer.

According to the results of the hydraulic calculations, it was found that when the thickness of the outer layer in the internal pipes of the heat exchange device is $\delta_1=0.1$ mm, the pressure loss due to friction during the movement of water increases to $\Delta P_{fr} = 168$ kPa, the pressure in local resistances to $\Delta P_{local\ res} = 82$ kPa, and the total hydraulic resistance of the device increases to $\Delta P_{gen} = 250$ kPa. It was found that with an increase in the thickness of the outer layer from 0.1 mm to 3.0 mm, ΔP_{fr} increases by 11.7 times, $\Delta P_{local\ res}$ by 10.2 times, and ΔP_{gen} by 11.3 times.

Table 2. The influence of the thickness of the coating on the hydraulic resistance indicators of the heat exchanger

The thickness of the coating layer on the surface of the pipe is δ , mm	Pressure lost due to frictional forces ΔP_{fr} , kPa	Pressure lost from local resistances ΔP_{local} res, kPa	Hydraulic resistance ΔP_{gen} , kPa
0.1	168	82	250
0,5	314	166	480
0,8	410	211	621
1,0	590	227	817
1,5	864	381	1245
2,0	1230	490	1720
2,5	1587	663	2250
3,0	1975	840	2815

Conclusion. The results obtained show that increasing the thickness of the outer layer on the surface of the heat exchange pipe, in addition to reducing its heat transfer characteristics, also leads to a sharp increase in the hydraulic resistance in the pipe. This increases energy consumption and negatively affects the operation of the device at full capacity.

References

1. Pavlov K.F., Romankov P.G., Noskov A.A. Primery i zadachi po kursu processov i apparatus chemical technology. - Leningrad: Khimiya, 1981. -272 p.
2. Salimov Z.S. Oil and gas processing processes and equipment. - T.: "Alokachi", 2010, - 508 pages.
3. Mikhaev M.A. Hydraulic raschyot napornykh truboprovodov. Injinerne stroitelnyy magazine, St. Petersburg. - 2012. - No. 6, - S. 20-28.
4. Semenov V.P. Razrabotka metodov intensivifikatsii processov teplomena pri condensatsii para v poverkhnostnyx i kontaktnyx teplo-mennikax: Autoreferat diss. ... Dr. tech. science - Yekaterinburg: Uralsky GTU, 2008. - 47 p.
5. Ismailov O.Yu., Khurmamatov A.M. The quality of the formation process of the study is dependent on the coefficient of the heat exchanger and the tube heat exchanger. Bulatovskie chteniya: materialy IV Mejdunarodnoy nauchno-prakticheskoy conference (31 times 2020): v 7 t.: sbornik statey / Pod obshch. ed. Dr. Tech. Nauk, Prof. O.V. Savenok. – Krasnodar: Izdatelsky Dom – Yug. T. 5: Chemical technology and ecology and oil and gas industry. - 2020. -S. 100-102.
6. Ismailov O.Yu., Khurmamatov A.M., Issledovaniya vliyaniya magnitnogo polya na protsess obrazovaniya nakipi v teplovykh ustroystvax/ Uzbekistan kimyo zurnal Tashkent. Issue 6 - 2022. 52-56 p.
7. Ismailov O.Yu. Device for learning the influence of the magnetic field on the process of deposit formation in heat exchanger devices/ Scientific and technical journal

of the Namangan Institute of Engineering Technology. - Namangan, 2022. Volume 7, 4th edition, p. 151-155.

8. Khurmamatov A.M., Ismailov O.Yu., Ismailov M.Kh., Umarov E.S. Dynamics of distribution of scale along the length of the heat exchange pipe / Fergana Polytechnic Institute, Fergana, -2023. Volume 27, Issue 1, p. 72-75.

9. Ismailov O.Yu., Ismailov M.Kh. The effect of magnetic field on the formation of mineral deposits in heat exchange devices / Collection of materials of the Republican scientific practical conference on the topic "Efficiency of using local minerals in the restoration of degraded soils". March 6, 2023. Defect. p. 178-181

10. Ismailov O.Yu., Ismailov M.Kh. Vliyaniya magnitnogo polya na protsess obrazovaniya nakipi v vodonagrevatelyakh Bulatovskie chteniya Materialy VII Mejdunarodnoy nauchno-prakticheskoy konferentsii 31 marta 2023 g. Russia Krasnodar 148 p

11. Ismailov O.Yu., Khurmamatov A.M., Ismailov M.Kh., Ausbaev A.U. Investigations of the impact of the magnetic field on the process of formation of scaling in thermal devices/ Journal Nafta-Gaz 2024. № 2. Pp. 115-124, DOI:10.18668/NG.2023.02.07.

12. Ismailov O.Yu ., Ismailov M.Kh. The influence of a magnetic field on the accumulation of foreign mass in heat exchange structures. Problems in chemical technology, chemical and food industries in the context of integration of science and production and ways to overcome them. Collection of materials of the Republican Scientific and Practical Conference. 2022. Namangan. -211-212 p.

13. Ismoilov O.Yu., Ismoilov M.Kh. The influence of a magnetic field on the process of external formation in heat exchange devices / 3rd International Scientific and Technical Conference on "Problems and Prospects of Innovative Techniques and Technologies in the Agricultural and Food Industry" Collection of conference materials of the international scientific and technical conference held at Tashkent State Technical University 20, 2023 -21 April 65-66-p.

14. Ismoilov O.Yu., Ismoilov M.Kh. Dependence of the heat transfer coefficient in heat exchangers on the thickness of the scale. Scientific and practical work "Fundamentals of the constant development of the magnetic field" of the Caspian University of Technology and Engineering named after Yesenov of the Republic of Kazakhstan Conference Proceedings Kazakhstan April 14, 2023 Volume 4 pp. 138-140

15. Ismailov O.Yu., Ismailov M.Kh. The influence of the magnetic field on the process of scale formation in water heaters. Collection of materials of the International Scientific Conference "The Fourth Industrial Revolution and Innovative Technologies" dedicated to the 100th anniversary of the birth of H. Aliyev, Azerbaijan. -May 3-4, 2023 - p. 50-51

16. Ismailov M.Kh . The influence of external formation in heat exchange devices of food industry enterprises on the efficiency of heat exchange. Problems in chemical technology, chemistry, and the food industry and ways to overcome them in the context

of integration of science and production Collection of materials of the Republican scientific and practical conference NamMTI 2022 June 3-4, 211-212-b

17. Ismailov O.Yu. Installation for studying the formation of deposits on the inner surface of heat exchanger tubes// Uzbek Chemical Journal. – Tashkent. –2016. – No. 6. – P. 49-55.

18. Ismailov O.Yu. Khurmamatov A.M., Buriyeva Z.R. Speed and hydrocarbon flows temperature influence on the process of scale formation/ Mejdunarodnoy nauchno-tekhnicheskoy konferentsii "Riski, vyzovy i problemy XXI veka v tsifrovoy transformatsii rationalnogo i bezopasnogo nedropolzovaniya" Tashkent. May 20-21, 2022. - C. 351-352.

19. Ismailov O.Yu. Calculation of hydraulic resistance in a horizontal pipe// Uzbek chemical journal. -Tashkent, 2013. - #6. - S. 73-75

20. Ismailov O.Yu., Rakhmanov T.Z. Izuchenie usloviya obrazovaniya otlozheniy v trubakh teploobmennyykh apparatax// Nauchno-tekhnicheskii zurnal, "Khimicheskaya promyshlennost". St. Petersburg, – 2017. – No. 2 – S. 74-78.

21. Voqqosov Z., Khudaiberdieva L., Xodzhazarova M. Studying the process of phenological monitoring of late varieties of plums grown in the climatic conditions of Namangan region //E3S Web of Conferences. – EDP Sciences, 2024. – T. 486. – C. 02012.

22. Zukhriddin, Vokosov, Kanoatov Khairullo Murodillaevich, and Sultonov Boxodir Elbekovich. "Obtaining Organomineral Fertilizers on Base of Local Raw Materials and Nitrogen-fixing Microorganisms." Chemical Science International Journal 31.4 (2022): 44-53.

24. Adashev, Bexzod va boshqalar. "UDK 664.34: 637.144 Rafinalangan O'simlik moylarini aralashtirish ko'rsatkichlari." Namangan muhandislik-texnologiya instituti ilmiy-texnikaviy jurnali 8.2 (2023): 87-91.

25. Адашев, Бегзод Шералиевич, Дилноза Саидакбаровна Салиханова, and Мухтасар Абдумуталлиб Кизи Исмоилова. "Улучшение биологических свойств растительных масел купажированием." Universum: химия и биология 4 (106) (2023): 44-48.

26. Khamdamov A. M., Sultonov S. H., Bozorov S. A. The main results of the study of the processes of deodorization of vegetable oils using wooden nozzles //Journal of Pharmaceutical Negative Results. – 2022. – C. 3844-3851.

27. Султанов С. Х., Хамдамов А. М., Артиков А. А. Эффективное использование плавающих деревянных насадок при интенсификации процессов массообмена //Universum: технические науки. – 2022. – №. 4-7 (97). – С. 46-48.

28. Sodikova S. USING SWEET SORGHUM SYRUP AS A SWEETENER //Universum: технические науки. – 2023. – №. 12-8 (117). – С. 11-13.

29. Abdurazzakovna S. S., Odilovich D. K. Research of physicochemical parameters of sugar sorghum juices //Scientific and technical journal of namangan institute of engineering and technology.

30. Eshonturaev A., Sodiqova S. Analysis of raw material sources for a plant-based milk alternative from almonds //E3S Web of Conferences. – EDP Sciences, 2024. – T. 486. – C. 02013.

CONTENTS

PRIMARY PROCESSING OF COTTON, TEXTILE AND LIGHT INDUSTRY

Korabayev Sh.	3
From street traffic to space: innovations in autonomous vehicles	
Egamov N.	10
Investigation of vertical forced vibration in the longitudinal - vertical plane of a binder that softens the crush between cotton rows	
Khamraeva S., Kadirova D., Davlatov B.	15
Determination of alternative technological factors for the production of functional fabric with a complex structure	
Khamraeva S., Kadirova D., Daminov A.	21
Designing fabrics for a given stretchability	
Kuliyev T., Rozmetov R., Tuychiev T., Sharipov Kh.	28
The effect of the angle of heat agent supply to the drying - cleaning equipment on cotton quality and cleaning efficiency of the equipment	
Abdujabbarov M., Alieva D., Karimov R.	35
Determination of the influence of the length of the tested yarn samples on their mechanical characteristics	
Jurayeva M., Nabidjonova N.	41
Research on physical and mechanical properties of fabric selected for special clothing of preschool children	
Yangiboev R., Allakulov B., Gulmirzayeva S.	45
Studying the alternative technological factors of the loom in the production of textiles based on basalt yarn	
Ganikhanov Kh., Mavlyanov A., Abdusamatov A., Mirzaumidov A.	55
Analysis of the maintenance parameters of the condenser	
Mavlyanov A., Mirzaumidov A.	60
The scientific basis of the lightened shaft	
Elmanov A., Mirzaumidov A.	69
Modeling of laser processing of thin-walled steel gears	
Nurillaeva Kh., Mirzaumidov A.	77
Cotton cleaner with multifaceted grates	
Ganikhanov Kh., Mavlyanov A., Abdusamatov A., Mirzaumidov A.	83
The equation of motion of cotton fiber in the condenser	
Khuramova Kh., Xoshimxojaev M.	89
Progressive method of cotton regeneration	

Abdulkarimova M., Lutfullaev R., Usmanova N., Mahsudov Sh.	94
Evaluation of aestheticity of women's dress models based on deep learning models	

GROWING, STORAGE, PROCESSING AND AGRICULTURAL PRODUCTS AND FOOD TECHNOLOGIES

Zufarov O., Isroilova Sh., Yulchiev A., Serkayev K.	101
Theoretical aspects of obtaining oxidation-stable vegetable oils	
Toshboyeva S., Dadamirzaev M.	110
Filling sauces for canned fish and their layer kinetics	
Atamirzaeva S., Saribaeva D., Kayumova A.	115
Prospects for the use of rose hips in food technology	
Turgunpolatova Sh.	121
Study of the quality of fruit pastela products	
Sultanov S.	126
Analysis of experiments on the process of deodorization of vegetable oil using floating nozzles	
Adashev B.	132
Physical-chemical analysis of oil taken from seeds of safflower	
Ismailov M.	137
Influence of surface layer thickness on hydraulic resistance of the device	
Khurmamatov A., Boyturayev S., Shomansurov F.	142
Detailed analysis of the physicochemical characteristics of distillate fractions	
Madaminova Z., Khamdamov A., Xudayberdiyev A.	154
Preparing peach seed for oil extraction and improving oil extraction through pressing	
Aripova K.	162
Methods of concentration of fruit juices and their analysis	
Djuraev Kh., Urinov Sh.	168
Theoretical and experimental study of the crack formation device in the shell of apricot kernels	

CHEMICAL TECHNOLOGIES

Urinboeva M., Abdikamalova A., Ergashev O., Eshmetov I., Ismadiyarov A.	175
Study of the composition and main characteristics of petroleum oils and their emulsions	
Tursunqulov J., Kutlimurotova N.	182
Application of 1-(2-hydroxy-1-naphthoazo)-2-naphthol-4-sulfo acid in amperometric determination of scandium ion	
Kucharov A.	191

Development of coal enrichment and gas extraction technology for the use of construction materials industrial enterprises	
Abdulkhaev T., Mukhammadjonov M., Mirzarakhimova F.	
Isotherm of benzene adsorption and differential heat of adsorption on AgZSM-5 zeolite	198
Vladimir L., Eshbaeva U., M.Ergashev	
Innovative environmental packaging for separating storage of two components, allowing to extend the lifetime without preservatives	204
Kodirov O., Ergashev O.	
Energetics of adsorption of water molecules to aerosol	212
Yusupov K., Erkabaev F., Ergashev D., Rakhimov U., Numonov M.	
Synthesis of melamine-formaldehyde resins modified with n-butanol	219
Ergashev O., Abdikamalova A., Bakhronov Kh., Askarova D., Xudoyberdiyev N., Mekhmonkhonov M., Xolikov K.	
Thermodynamics of Congo red dye adsorption processes on mineral and carbon adsorbents	228
Ergashev O., Maxmudov I.	
Water vapor adsorption isotherm in zeolites regenerated by microwave thermoxidation method	235
Jumaeva D., Zaripbaev K., Maxmudov F.	
The elements and oxide content of the chemical composition of the feldspar	242
MECHANICS AND ENGINEERING	
Khudoyberdiev U., Izzatillaev J.	
Analysis of research on small wind energy devices	249
Atajonova S.	
Mathematical model of system analysis of technological processes in the form of key principles for effective decision-making	258
Kuchkarbayev R.	
Mathematical modeling of heat transfer through single-layer and multi-layer cylindrical walls in buildings and structures	264
Atambaev D.	
Difference in the length of individual yarn composition of twisted mixed yarn and comparative analysis of single-thread elongation deformations	269
Abdullayev S.	
Modeling the functionalities of an automated system for managing movement in the air	276
Turakulov A.	
Describing computational domains in applications for solving three-dimensional problems of technological processes	285
Mamaxonov A.	

Mathematical model of machine aggregate of tillage equipment process	293
Khudayberdiyev A.	
Technical and economic aspects of processing pyrolysis distillate into motor fuel	304
Abdurahmonov J.	
Research results on the selection of the mesh surface of a lint-cleaning device	311
Vohidov M.	
Development of a program for determining eccentricity by analyzing the magnetic field in the air gap of an asynchronous motor	319
Utaev S., Turaev A.	
Analysis of methods and prospects for application of optical methods for control of working surfaces of cylinder liners of internal combustion engines	327
Boltabayev B.	
Determination of seed damage in the pneumatic transport system by conducting experiments	335
Azizov Sh., Usmanov O.	
Simulation of equation of motion of the new construction gin machine	339
Sharibaev N., Homidov K.	
Theoretical analysis of the coefficient of friction induced by the pressure force of a vertical rope acting from above and below	347
Aliyev B., Shamshidinov M.	
Improvement of the linter machine and development of its working scheme	356
Mukhametshina E.	
Analysis of cotton flow behavior in different pneumatic pipes	362
Yangiboev R., Allakulov B.	
Obtaining and analyzing correlational mathematical models of the sizing process	369
Mirzakarimov M.	
Efficient separation of fibers from saw teeth in the newly designed gin machine	379
Azambayev M.	
Measures to improve the quality of fluff	387
Abdullayev R.	
Scientific innovative development of cotton gining	392
Kholmiraev F.	
Air flow control factors in pneumatic transport device	397
Sharibaev N., Makhmudov A.	
Separation of cotton from airflow in pneumatic transport systems of the cotton industry	404
Sharibaev N., Mirzabaev B.	

Effect of steam temperature on yarn moisture regulation in textile industry	410
Sultanov S., Salomova M., Mamatkulov O.	
Increasing the useful surface of the mesh surface	415
Muhammedova M.	
Kinematics of the foot in a healthy person's foot and ankle injury	421
ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION	
Abdullayev H.	429
Algorithm for creating structured diagrams of automatic control systems	
Kodirov D., Ikromjonova N.	437
On delayed technological objects and their characteristics	
Uzokov F.	444
Graphing circles, parabolas, and hyperbolas using second-order linear equations in excel	
ECONOMICAL SCIENCES	
Zulfikarova D.	449
Issues of developing women's entrepreneurship	
Ergashev U., Djurabaev O.	455
Methods for assessing the effectiveness of waste recycling business activities in the environmental sector	