AMERICAN JOURNALS
Open Access, Peer Reviewed Journals
American Journal of Business Management, Economics and Banking
ISSN (E): 2832-8078 Volume 31, | December - 2024

PRINCIPLES OF SELECTING NOZZLES FOR OIL REFINERY REACTORS

N. U. Toshmatov,
Sh. P. Mansurova
Jizzakh Polytechnic Institute

A B S T R A C T	K E Y W O R D S
The article examines the issues of new ways to increase the efficiency of technological processes and improve the internal devices of reactors, the location of nozzles on the surface of the plate, gas flow rates, the cross-section of the nozzle with a flat diffuser.	Burner, diffuser, nozzle, flow velocity, turbulence, combustion zone.

Introduction

At present, reactors of petrochemical plants use distribution plates with a large number of tubular nozzles, the design of which varies. Modern requirements for the quality of oil refining products, in particular for the content of harmful impurities (for example, sulfur), force us to look for new ways to increase the efficiency of technological processes and improve the internal devices of reactors containing a catalyst layer. Reactors use open-type nozzles, while other manufacturers close the outlet section of the nozzle branch pipe with a flat divider, installing it at a distance of 0.1-0.25 percent of the branch pipe diameter.

In these nozzles, the liquid flow is supplied to the diffuser, highly dispersed distribution, having a perforation degree of 2-3%, uniform arrangement of nozzles on the surface of the plate. The corresponding gas flow rates in the nozzle pipes are provided by the assignment of the perforation degree of the plate and are 2.4-4.15 m/s for the specified flow range.

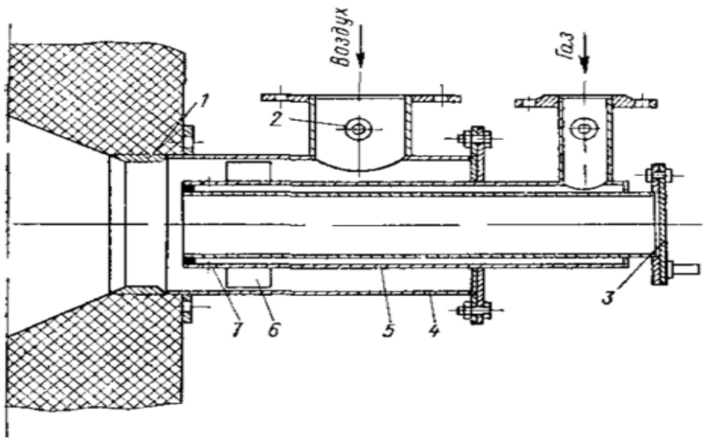


Figure 1. Open type injectors

Numerous experiments have shown that for this type of flows in the zone between the distribution plate and the catalyst bed, the influence of the similarity criteria of the Froude and Euler numbers is practically insignificant. The structure of the gas flow is determined mainly by the Reynolds number, i.e. the influence of viscous forces, therefore, when determining the parameters of the experimental setup, we proceeded from the requirement of equality of the Reynolds numbers for flows in natural (in reactors) and experimental conditions, which would ensure the identity of the flow pattern in the studied zones.

The Reynolds number for the flow zone under consideration is appropriate to determine by the parameters of the nozzle branch pipes: internal diameter of 40 mm and flow velocity through the nozzle V m/sec. Let us dwell on the choice of the type of flow as the working medium and compare the corresponding indicators of kinematic viscosity and. Average value for the working flow in reactors: 0.9875*10-6 m2/sec, Corresponding values for air and water, m2/sec; water 1.0*10-6. air 18.09*10-6

Comparing the kinematic viscosities of the working flow in the reactor, water and air, we see a practical coincidence of their values for the working medium and water. It follows that the Reynolds numbers determined for the reactor zone and the experimental setup will coincide under the following conditions:

- identity of the geometry of the nozzles and the flow zone under study;
- the working fluid that forms the flow in the experimental setup;
- equality of flow rates through nozzles in full-scale and experimental setups.

Since the flow occurs at high pressure and temperature, the implementation of these conditions during the experimental work requires separate consideration. When implementing these conditions in the experimental setup, the flow structures, their dynamics and other indicators obtained during the experimental work will be identical to the processes occurring in reactors under the operating conditions of their operation. In this case, there is no need to create high pressures and maintain high temperatures.

2. Materials and research methods

The geometric appearance of the experimental setup is determined from the following conditions. Due to the symmetry of the placement of the nozzles over the area of the plate, each of them has its own zone of influence, limited on the sides by six zones from neighboring nozzles with similar parameters, inside which the flow structure is formed. Interaction with neighboring flows from other nozzles occurs along the common boundaries of the zone. To obtain a flow pattern in the zone of action of the nozzle, taking into account the influence of neighboring zones, a "cut" of the working zone is carried out in depth from the plate to the catalyst layer with three nozzles located in one line, while the choice of the direction of this line in the plane of the plate is of no importance due to the symmetry of the arrangement of the nozzles.

3.Research results

The experimental work was carried out as part of a certified reference pouring stand intended for testing measuring instruments for the needs of heat engineering. The stand is equipped with measuring and automation instruments for creating and maintaining water flow rates and speeds with the required accuracy.

The experimental setup has a removable transparent panel on the top and a transverse metal insert on which three nozzles with replaceable diffusers are mounted. Each nozzle has a pipeline for feeding colored liquid into the nozzle branch pipe to visualize the flow pattern. The colored liquid is fed from a separate container and under pressure. Water was used as the working medium, as defined above. The setup is designed to operate under pressure up to 0.1 MPa.

From a wide variety of nozzle divider options, five of the most functionally and technologically promising ones in terms of manufacturing and installation were selected.

For each variant of the diffuser, the flow rate in the nozzle branch pipe was varied during the tests, m/e: 2.4; 3.3; 4.15.

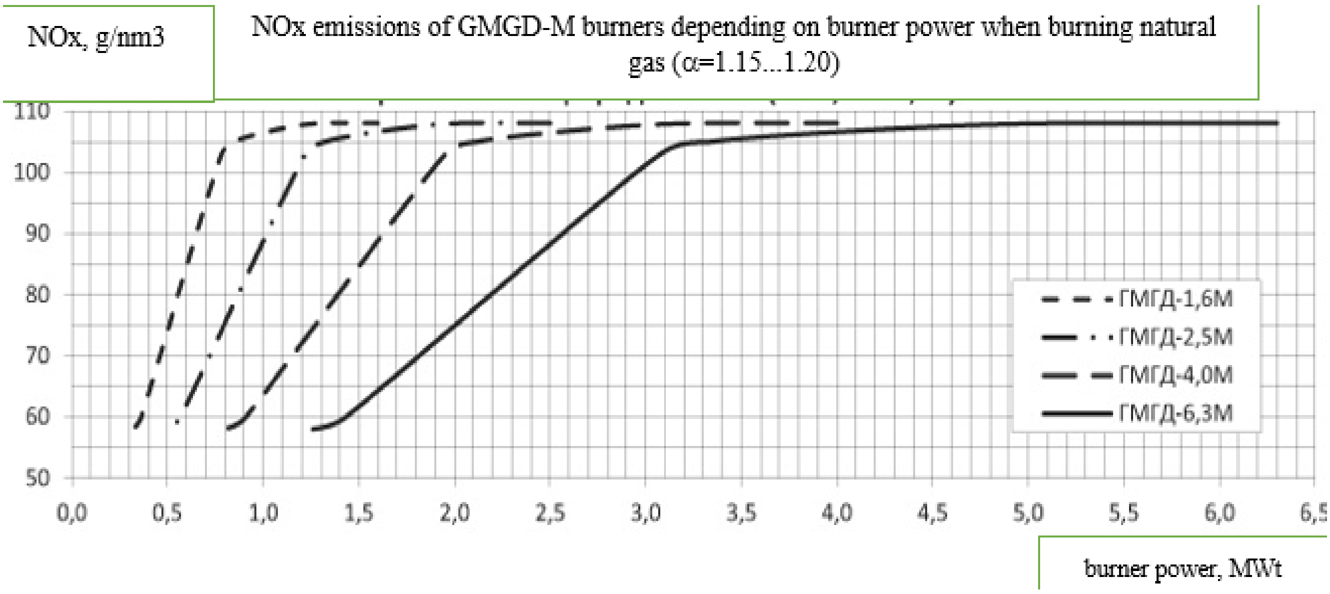
The flow structures were recorded for 300 seconds by a portable video camera and, after computer processing, were converted into computer video films and frame-by-frame file structures with a frequency of 50 frames/sec.

It should be noted that the flow rates through the nozzles were formed and maintained by the stand systems stationary during the entire time of pouring a specific variant, whereas for all variants of diffusers and flow modes in the studied zone, non-stationary flow patterns with different linear scales of turbulence and parameters of vortex structures were formed, which corresponds to Reynolds numbers of 2.5*105.

4. Analysis of research results

Based on the experiment, it was established that the greatest uniformity of the flow structure or the least turbulence is provided by nozzles with diffusers of option No. 3.

This diffuser has a perforated disk with a perforation rate of 15-27%, diameter d = 1.500 (d is the internal diameter of the nozzle), installed at a distance hd from the branch pipe cut. The flow pattern is characterized by uniform expansion downstream with a weak turbulent structure, i.e. with weak velocity disturbances in the cross section of the jet, which can be taken as the required flow structure. An increase in the flow velocity leads to an increase in the scale of turbulence, but to acceptable values, i.e. extensive vortex structures with reverse flows are not formed.



Based on the research, it has been experimentally established and when comparing the structure of the flows formed by all the considered variants of the nozzles, it is evident that the greatest uniformity of the flow structure or the least turbulence is provided by the nozzle with the diffusers of variant No. 3.

5. Conclusions and recommendations

Considering the obvious advantages in the formation of the flow as a whole behind the reactor distribution plate, as well as the technological efficiency of manufacturing this version of the diffuser, the gas-oil burner GMGD-4.0M is recommended for use in the design of the nozzle as part of the distribution plate as a whole.

References

1. Mansurova Sh. P. (2023). Issues of pressure regulation in heating networks. в international bulletin of applied science and technology (Volume 3, Issue 10, October. 510–516).
2. Tashmatov, N.U., & Mansurova, S.P. (2022). Some Features of Heat and Moisture Exchange in Direct Contact of Air with a Surface of a Heated Liquid. International Journal of Innovative Analyses and Emerging Technology, 2(1), 26–31.
3. Karimovich, T.M., & Obidovich, S. A. (2021). To increase the effectiveness of the use of Information Systems in the use of water. Development issues of innovative economy in the agricultural sector, 222-225.
4. Sattorov, A., & Karimov, E. (2023). Qurilish materialini ishlab chiqaruvchi sanoat pechlarida gaz yoqilg‘isi yonuv issiqliq miqdorlarining nazariy tenglamalarini tuzish. Educational Research in Universal Sciences, 2(13), 313–317.
5. Sultonov, A. (2019). Water use planning: a functional diagram of a decision-making system and its mathematical model. International Finance and Accounting, 2019(5), 19.
6. Toshmatov N.U., Mansurova Sh.P. (2022). Studying Some Parameters of the Composition and Evaluation of the State of Industrial Gas Emissions and Their Components. European Journal of Innovation in Nonformal Education (EJINE) Volume 2. 243-248.
7. Sultonov, A., & Turdiqulov, B. (2022). Suv qabul qilish inshootlarining ishlash samaradorligini oshirishda filtrlarning o‘rni. Евразийский журнал академических исследований, 2(11), 12-19.
8. Turdiqulov, B., Nazirov, S., & Karimov, Y. (2022). Atom va molekulalarning yorug’likni yutishi va nurlanishi. Евразийский журнал академических исследований, 2(13), 1252-1258.
9. Tashmatov, N.U., & Mansurova, S.P. (2022). Specific Features of Change in Surface Temperature of Evaporating Liquid from Hydrodynamic and Temperature-Humidity Conditions. International Journal of Innovative Analyses and Emerging Technology, 2(1), 20–25. Retrieved from http://openaccessjournals.eu/index.php/ijiaet/article/view/904.
10. Mansurova Sh.P. (2023). Peculiarities of Calculation of Vortex Dust Collectors by Determining its Geometry. Eurasian Journal of Physics, Chemistry and Mathematics, 16, 87–90. Retrieved from https://www.geniusjournals.org/index.php/ejpcm/article/view/3711.
11. Tashmatov, N. U., & Mansurova, S. P. (2022). Studying Some Parameters of the Composition and Evaluation of the State of Industrial Gas Emissions and Their Components. European Journal Of Innovation In Nonformal Education, 2(5), 243–248. Retrieved from https://www.inovatus.es/index.php/ejine/article/view/891.

12. Turdiqulov, B. (2022). Gaz yondirgichlarning ishlash jarayonini takomillashtirish. Евразийский журнал академических исследований, 2(11), 4-11.
13. Sh.P. Mansurova. (2021). Application of renewable energy sources in buildings. Galaxy International Interdisciplinary Research Journal, 9(12), 1218–1224.
14. Sattorov, A., & Karimov, E. (2023). Havo almashinuv tizimida uyni isitishga sarflanadigan issiqlik qiymatini xisoblash. Educational Research in Universal Sciences, 2(13), 318–321.
15. Toshmatov N. U., & Mansurova Sh. P. (2022). Efficiency of use of heat pumps. International Journal of Innovations in Engineering Research and Technology, 9(10), 1–5.
16. Nazirov, S. O. o‘g‘li. (2023). Global suv tanqisligi davrida suv ta’minoti tizimlarini takomillashtirish masalalari. Educational Research in Universal Sciences, 2(13), 109–115.
17. Karimov, Y. N. (2022). Aholini ichimlik suvi bilan ta’minlash muammolari. Science and Education, 3(12), 369-375.
18. Mansurova, S. (2023). SOLAR HEATING SYSTEMS FOR BUILDINGS. International Bulletin of Applied Science and Technology, 3(11), 311–315.
19. Каримов, Э.Т.ў. (2023). Мамалакатимизда енгил автомобил ювиш шахобчаларининг оқова сувларини оқизишда янги тизимларни ишлаб чиқиш. Educational Research in Universal Sciences, 2(13), 263–267.
20. Zhukovskaya Irina Evgenievna, Mansurova Shakhnoza Pulatovna. Passive heating of buildings based on the principle of direct solar heating. journal of engineering, mechanics and modern architecture no.2(2023). ”Urgent problems of improving the system of personnel training in the architectural and construction areas" https://jemma.innovascience.uz/index.php/jemma/issue/view/12
21. Юлдашева, А., & Султонов, А. (2024). Qishloq aholi punktlarining ichimlik suv ta’minoti tizimidagi muammolari. Interpretation and Researches. извлечено от https://interpretationandresearches.uz/index.php/iar/article/view/2667.
22. Kenjabaev A.T., Sultonov A.O. “The role and place of agro clusters in improving the economic efficiency of water use in the region” “The Asian Journal of Multidimensional Research (AJMR).” ISSN: 2278-4853 Vol 7, Issue 11, November 2018, 147 p.
23. Yurchenko I.F. Methodological bases for creating an information system for managing irrigation water use. Vestnik rossiiskoi selskokhozyaistvennoi nauki. 2017. No. 1. pp. 13-17.
24. Kenzhabayev, A.T., & Sultonov, A.O. (2019). Agroclusterization is the most important tool for saving water resources. In Collection of scientific articles on the results of the International Scientific Forum (p. 105).
25. Бобомуродов, У.С., & Султонов, А.О. (2016). Методы улучшения реагентного умягчения воды в осветлителях. Молодой ученый, (7-2), 51-53.
26. Obidovich, S. A. (2020). The use of Modern Automated Information Systems as the Most Important Mechanism for the use of Water Resources in the Region. Test Engineering and Management, 83, 1897-1901.
27. Kenjabayev, A. and Sultanov, A. (2019) "Development of software on water use," *Problems of Architecture and Construction*: Vol. 2: Iss. 1, Article 11. Available at: https://uzjournals.edu.uz/samgai/vol2/iss1/11.
28. Султанов, А. О. (2019). Информационная система водных ресурсов селского хозяйства. Проблемы научно-практической деятелности. Перспективы внедрения, 197.

29. Sultonov, A. O. (2020). Problems of optimal use of water resources for crop irrigation. Journal of Central Asian Social Studies, 1(01), 26-33.
30. Sultonov, A. (2019). Water use planning: a functional diagram of a decision-making system and its mathematical model. International Finance and Accounting, 2019(5), 19.
31. Sultonov, A., Musaev, S., Xajimatova, M., Ustemirov, S., & Sattorov, A. (2021). Pollutant Standards for Mining Enterprises. *EasyChair*, (5134).
32. Такабоев, К.У., Мусаев, Ш.М., & Хожиматова, М.М. (2019). Загрязнение атмосферы вредными веществами и мероприятие их сокращение. Экология: вчера, сегодня, завтра, 450-455.
33. Enda O'Connell. Towards Adaptation of Water Resource Systems to Climatic and Socio-Economic Change.Water Resources Management August 2017, Volume 31, Issue 10, pp 2965–2984.
34. Internet resource. Meeting on the results of reforms in the water management system in 2019 and priorities for the future, 25.01.2020: http://www.water.gov.uz/uz/posts/1545735855/371
35. Mansurova Sh.P. Features of humid air during processing with sorbents // High technologies, science and education: topical issues, achievements and innovations. - 2020. - S. 82-84
36. Кенжабаев, А.Т., Жумаев, К.Х., & Султонов, А.О. (2022). Автоматлаштирилган сув узатиш тармоқларини ишлаш алгоритми. *Eurasian Journal of Academic Research*, *2*(10), 78-87.
37. Sultonov, A., & Turdiqulov, B. (2022). Suv qabul qilish inshootlarining ishlash samaradorligini oshirishda filtrlarning o 'rni. *Eurasian Journal of Academic Research*, *2*(11), 12-19.
38. Тунсунбоев, Н. (2023). Сув ресурсларини муҳофаза қилишда оқова сувларини тозалашнинг ахамияти. *THE BEST STUDENT OF THE CIS*, *1*(1).
39. Ибрагимов, З. (2023). Жизах вилоятини сув билан таъминлаш тизимини яхшилаш йўллари. *THE BEST STUDENT OF THE CIS*, *1*(1).
40. Турдубеков, У.Б., Джураева, К.Г., & Султанов, А.О. (2023). К методологии количественной оценки безопасности информационной системы безработицы в экономике: синергетический подход. In *Проблемы информационной безопасности социално-экономических систем* (pp. 27-28).
41. Obidovich, S.A., & Telman, T.N. (2023). Improving the use of information systems in conserving water resources. *journal of engineering, mechanics and modern architecture*, (2), 453-457.
42. Libert, B., Akmal, S., & Saidavzal, A. (2023). The role of the geographic information systems in the water supply systems. *Journal of Universal Science Research*, *1*(11), 459-467.
43. Evgenevna Z. I., Obidovich S. A., Nodir T. Assessment of the efficiency of water resources use based on information technology data //Journal of Universal Science Research. – 2023. – Т. 1. – №. 11. – С. 226-231.
44. Nazirov Sanjar, & Karimov Yusuf. (2023). Yer osti muhandislik tarmoqlarini joylashtirish va ularning mustahkamlik parametrlarini aniqlash. Innovations in Technology and Science Education, 2(9), 402–408.
45. Максимчук О.В., Мансурова Ш.П. Рекуперация воздуха в системе вентиляции. Международный научно-практический журнал "Экономика и социум". Стр. 1046-1049. Выпуск № 1(116) 2024. Сайт: http://www.iupr.ru.

46. Mansurova Sh.P. (2024). Processes of Heat And Moisture Exchange of the Surface of a Heated Liquid in Direct Contact With the Environmental Air. *Miasto Przyszłości*, *54*, 630–634. Retrieved from https://miastoprzyszlosci.com.pl/index.php/mp/article/view/5279.
47. Toshmatov N. U. (2024). Temperature and Humidity Changes in the Surface of Evaporating Liquid Depending on Hydrodynamic Conditions. *American Journal of Education and Evaluation Studies*, *1*(8), 113–118. Retrieved from https://semantjournals.org/index.php/AJEES/article/view/454.