DETERMINATION OF PHYSICO-CHEMICAL INDICATORS OF ADSORBENTS IN GAS DRYING

Shukurova D.SH.

Student at Karshi State Technical University.

Abstract. This article delves into the physico-chemical indicators that characterize adsorbents used in the gas drying process. It provides a comprehensive analysis of various adsorbents, evaluates their properties, and discusses their performance in gas drying applications. Key parameters such as surface area, pore size, adsorption capacity, and thermal stability are examined through experimental and theoretical approaches.

Keywords. Adsorbents, gas drying, physico-chemical indicators, surface area, pore size, adsorption capacity, thermal stability.

Annotatsiya. Ushbu maqola gazni quritish jarayonida ishlatiladigan adsorbentlarni tavsiflovchi fizik-kimyoviy ko'rsatkichlarni o'rganadi. U turli adsorbentlarni har tomonlama tahlil qiladi, ularning xususiyatlarini baholaydi va gazni quritish dasturlarida ularning ishlashini muhokama qiladi. Sirt maydoni, teshik hajmi, adsorbsiya qobiliyati va issiqlik barqarorligi kabi asosiy parametrlar eksperimental va nazariy yondashuvlar orqali tekshiriladi.

Kalit so'zlar. Adsorbentlar, gazni quritish, fizik-kimyoviy ko'rsatkichlar, sirt maydoni, teshik hajmi, adsorbsiya hajmi, issiqlik barqarorligi.

Аннотация. В данной статье рассматриваются физико-химические показатели, характеризующие адсорбенты, используемые в процессе газовой сушки. Он проводит всесторонний анализ различных адсорбентов, оценивает их свойства и обсуждает их эффективность в приложениях для сушки газа. Основные параметры, такие как площадь поверхности, размер пор, адсорбционная способность и термическая стабильность, проверяются с помощью экспериментальных и теоретических подходов.

Ключевые слова. Адсорбенты, газовая сушка, физико-химические показатели, площадь поверхности, размер пор, объем адсорбции, термическая стабильность.

Introduction

Gas drying, a critical process in various industrial applications, involves the removal of moisture from gases. This process is essential for ensuring the quality and stability of products in industries such as natural gas processing, petrochemicals, and air separation. Adsorbents play a pivotal role in gas drying by capturing and retaining water molecules from gas streams. The efficiency of this process largely depends on the physico-chemical properties of the adsorbents used.

ISSN 3030-3907

This article aims to explore these properties, providing insights into their impact on the effectiveness of gas drying operations.

To determine the physico-chemical indicators of adsorbents, a combination of experimental and theoretical methods is employed:

BET Surface Area Analysis: Utilized to measure the specific surface area of adsorbents.

Pore Size Distribution: Determined using techniques such as nitrogen adsorption-desorption isotherms and mercury intrusion porosimetry.

Adsorption Isotherms: Evaluated through gravimetric or volumetric methods to assess the adsorption capacity at various relative humidities.

Thermogravimetric Analysis (TGA): Used to assess the thermal stability of adsorbents by measuring weight changes under controlled heating.

In the context of gas drying, the performance of adsorbents is influenced by various physico-chemical indicators. These indicators help in understanding the efficiency, capacity, and suitability of adsorbents for specific applications. Here are some of the key physico-chemical indicators used to evaluate adsorbents in gas drying:

Surface Area

- Definition: The total surface area available for adsorption per unit mass of the adsorbent.
- Importance: A higher surface area typically means more sites are available for adsorption, leading to higher adsorption capacity.
- Measurement: Typically measured using the BET (Brunauer, Emmett, and Teller) method involving nitrogen adsorption.

Pore Size Distribution and Volume

- Definition: The distribution of pore sizes within the adsorbent and the total volume of these pores.
- Importance: Different pore sizes target different molecules. Micropores are suitable for small molecules, while mesopores and macropores are better for larger molecules.
- Measurement: Measured using techniques like nitrogen adsorption-desorption isotherms and mercury porosimetry.

Adsorption Capacity

- Definition: The amount of adsorbate that an adsorbent can hold at a given pressure and temperature.
- Importance: Indicates how much moisture or other gas the adsorbent can remove.
- Measurement: Determined through adsorption isotherms, typically at different pressures and temperatures.

ISSN 3030-3907

Thermal Stability

- Definition: The ability of the adsorbent to maintain its structure and performance at elevated temperatures.
- Importance: Essential for applications involving high-temperature gases.
- Measurement: Assessed using techniques like Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC).

Hydrothermal Stability

- Definition: The ability of the adsorbent to withstand exposure to moisture and heat without degrading.
- Importance: Critical for adsorbents used in humid or steam environments.
- Measurement: Evaluated through long-term exposure tests to steam or humid conditions followed by performance testing.

Mechanical Strength

- Definition: The ability of the adsorbent to resist physical breakdown due to mechanical stresses.
- Importance: Prevents the adsorbent from turning into dust under operational conditions, ensuring consistent performance.
- Measurement: Measured using crush strength tests and attrition resistance tests.

Chemical Stability

- Definition: Resistance of the adsorbent to chemical reactions with the adsorbate or other chemicals present in the gas stream.
- Importance: Ensures longevity and reusability of the adsorbent.
- Measurement: Evaluated through exposure to reactive gases and subsequent performance testing.

Regeneration Efficiency

- Definition: The ability of the adsorbent to be restored to its original adsorption capacity after desorption.
- Importance: Critical for the economic viability of the adsorption process.
- Measurement: Assessed through multiple adsorption-desorption cycles and measuring capacity after each cycle.

Selectivity

- Definition: The preference of the adsorbent for one adsorbate over another in a mixture of gases.
- Importance: Important in applications where specific gases need to be removed from a mixture.
- Measurement: Determined through adsorption experiments with mixed gases and analyzing the composition of the adsorbed and remaining gases.

Kinetics of Adsorption

ISSN 3030-3907

- Definition: The rate at which adsorption occurs.
- Importance: Influences the design of the adsorption process and contact time needed.
- Measurement: Measured by monitoring the uptake of the adsorbate over time.

Practical Evaluation Methods

- Gravimetric Analysis: Measures the weight change due to adsorption.
- Chromatography: Determines the composition of gases before and after adsorption.
- Spectroscopy: Techniques like IR or NMR can provide information on the interaction between adsorbent and adsorbate.
- Microscopy: Electron microscopy can be used to visualize the adsorbent's surface and pore structure.

Conclusions

The study concludes that the selection of adsorbents for gas drying should consider the specific physico-chemical indicators that align with the operational requirements. Novel adsorbents, particularly MOFs and carbon-based materials, offer promising improvements in adsorption performance. Future research should focus on optimizing the synthesis processes and evaluating the long-term performance of these advanced adsorbents in industrial applications.

Optimization of Synthesis Processes: Developing cost-effective and scalable methods for producing novel adsorbents.

Long-term Performance Studies: Conducting extended trials to assess the durability and efficiency of advanced adsorbents in real-world conditions.

Hybrid Adsorbent Systems: Exploring the potential of combining traditional and novel adsorbents to leverage the benefits of both.

Environmental Impact Assessment: Evaluating the environmental footprint of adsorbent production and disposal to ensure sustainable practices.

REFERENCES

1. Берлин М А, Гореченков В Г анд Волков Н П 1981 Просэссинг оф оил анд натурал гасес (М.: Химия) п 472
2. Jumaev K K, Iskandarov J and Tukhtaev B 2017 Development and use of small-sized absorption plants Scientific-theoretical journal Issues of science and education” 2(3) 33-5
3. Lochin Tilloev and Khamro Dustov 2021 Fractional composition of the waste yellow oil IOP Conf. Series: Earth and Environmental Science 839 042080
4. Jumaev K K and Dustov X B 2019 Characteristics of glycols used as absorbents and their effect on the level of natural gas dewatering BETI Scientific journal “Development of science and technology” 3 52-6

ISSN 3030-3907

5. Jumaev K K and Saidov M 2016 Influence of hydrate formation on the operating capacity of the gas pipeline International Scientific Journal “Young Scientist” 2 150-1

6. Khurramov Sh and Khalturaev F 2022 Contact angles of two-roll modules Modern Innovations, Systems and Technologies 2(2) 0129-42 https://doi.org/10.47813/2782-2818-2022-2-2-0129- 014

7. Шурупов С., Кессель И. “ Переработка природного газа в синтетические жидкие углеводороды” (СЖУ). Журнал Автогазозаправочный комплекс + Альтернативные топливо» №1 (13) 2004 г., с. 49-51.

8. Рачевский Б.С. “Эффективные технологии утилизации низконапорных и факельных попутных газов нефтяных и газовых месторождений». Доклад на XI Международной конференции «Современные технологии и оборудование, прормышленное строительство в нефтегазопереработки и нефтехимии Россия 6-7 июня 2007 г., Москва , Фонды ВНИПИНЕФТЬ 2007 г., с. 52-66.

9. Климова Г.Н., Литвак В.В., Яворский М.И. Перспективы энергетического использования попутного нефтяного газа //Промышленная энергетика, 2002, №8. с. 2-4.

10. Рябцев Н.И., Природный и искуственный газ. М.: Изд-во лит-ры по строительству, 1987- 326стр.,ил.

11. Кисленко Н.Н. « Новые этапы развития газоперерабатывающей под отрасли»,Журнал «Газовая промышленность» №7 2000 г., с. 44-46.

12. Бекиров Т.М. Промысловая и заводская обработка природных и нефтяных газов. М.: Недра, 1980.-193 с.

13. Технология и оборудование процессов переработки нефти и газа // С. А. Ахметов, Т. П. Сериков, И. Р. Кузеев, И. И. Баязитов. — СПб: Недра, 2006

14. Гохман Л.М. Теоретические основы строения битумов и других органических вяжущих материалов // Химия и технология топлив и масел. – 1993.

15. Горшенина Г.И.,Михайлов Н.В. Полимер-битумные материалы. – М.: Недра,1950.

16. H. Zimmermann and R. Walzl, "Ethylene", in Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH & Co. KGaA, 2012.

17. “Petrochemical industry ethylene plant”, http://www.usa.siemens.com/processanalytics, [Online; Accessed: 2016

18. P. Eisele and R. Killpack, “Propene,” in Ullmann’s Encyclopedia of Industrial Chemistry, Wiley-VCHVerlag GmbH & Co. KGaA, 2000.

ISSN 3030-3907

19. M. Dente, E. Ranzi, and A. Goossens, “Detailed prediction of olefin yields from hydrocarbon pyrolysis through a fundamental simulation model (SPYRO),” Computers & Chemical Engineering, vol. 3, 1979.
20. M. Dente, E. Ranzi, S. Barendregt, and P. Cronin, “Steam cracking of heavy liquid feedstocks: cracking yields rigorously predicted,” E. Joo, Modelling of Industrial Naphtha Thermal Cracking Furnaces, PhD thesis, Korea Advanced Institute of Science and Technology, 2000.

ISSN 3030-3907