CARBONATE CONVERSION OF METHANE

F.F.Nazarov*; F.S.Nazarov*; F.U.Axmedova*; N.I.Fayzullayev**

*Karshi Engineering and Economics Institute,
UZBEKISTAN
Email id:feruz-nazarov-88@mail.ru

**Samarkand State University,
UZBEKISTAN

ABSTRACT

*In the study, the factors influencing the catalytic carbonation reaction of methane were studied in the presence of a catalyst containing Ni_2O_3) x * (Co_2O_3) y * (ZrO_2) z * (MoO_3) k: The analysis of the composition of the resulting synthesis gas was carried out using a Chromatograph "Kristallux-4000M". We used columns 3 m long and 3 mm in inner diameter. Helium was used as a carrier gas. The phases in the columns are molecular sieves 5A and Haysep Q.Phase in columns - molecular sieve 5A i Haysep Q. Determination of the quantitative composition of gas mixtures was carried out by an external standard method (chromatograph was pre-set for each component of the gas mixture):*

KEYWORDS: *Methane, Carbon Dioxide, Conversion, Selectivity.*

INTRODUCTION

Today, 15 billion tons of carbon dioxide are released into the atmosphere annually around the world [1-8]. As a result of such a sharp increase in the amount of carbon dioxide in the atmosphere, the temperature on Earth is projected to rise by 0.35^OS in the next 15-20 years, and by $1.5-2^OS$ in 100-120 years. This poses global environmental and economic challenges. The most promising way to solve this environmental problem is to synthesize a gas by converting carbon dioxide with methane and producing methanol based on it [9-11].

The process of converting methane to carbon dioxide and obtaining a "synthesis gas" has not yet been introduced into the industry due to the lack of a long-lasting stable catalyst, but it is important in terms of CO_2 loss. Carbonate conversion of methane is also a promising method with the simultaneous use of two different gases (methane and carbon dioxide) that evoke the

"greenhouse effect" and has significant environmental and economic significance.Natural gas is widely used in industry. At the moment, saving natural gas is relevant. One of the ways to reduce the consumption of natural gas is its conversion of various types. The use of conversion products as fuel increases the amount of energy received in comparison with the original natural gas, and also increases the combustion temperature, gives an energy-saving effect, especially in high-temperature processes [8-10]. Natural gas conversion types:

- Steam conversion;

- Carbon dioxide conversion;

-high temperature oxygen conversion;

-catalytic steam-oxygen conversion in shaft reactors;

-catalytic steam-carbon dioxide conversion in tube furnaces.

The most promising way to carry out methane conversion is a combination of methane oxidation with oxygen, steam and carbon dioxide conversion of methane. The combination of two or three types of oxidative conversion of methane can lead to an increase in the efficiency of the use of raw materials, an improvement in the heat balance and makes it possible to adjust the composition of the synthesis gas. The addition of CO_2 to the $CH_4 + H_2O$ mixture allows the composition of the resulting synthesis gas to be optimized in accordance with the composition required for further processing.

The purpose of the study: to study the kinetic laws of the process of "synthesis-gas" conversion of methane to carbon dioxide in a differential reactor and to propose the kinetic equation of the reaction.

EXPERIMENTAL PART:

The schematic diagram of the laboratory unit for steam-carbon dioxide conversion of methane is shown in the picture. 1, and a general view of the installation in the picture. 2.
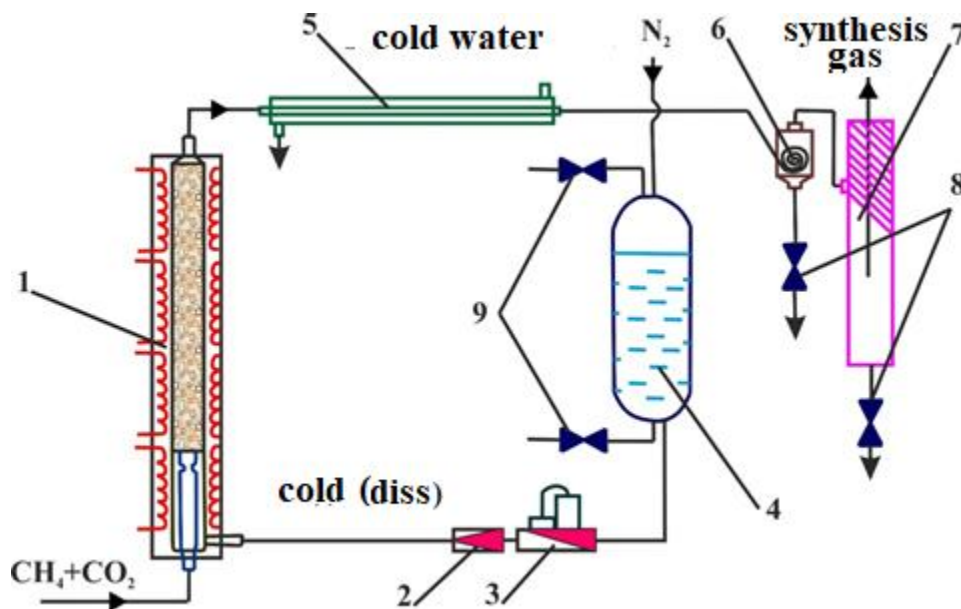
Picture - 1. Scheme of block metamorphic methane conversion: 1-reactor conversion, 2 - check valve, 3 - flow meter, 4 - cylinder with water, 5 - refrigerator, 6 - cyclone, 7 - separator, 8, 9 - valves.

The analysis of the composition of the resulting synthesis gas was carried out using a Chromatograph "Kristallux-4000M". We used columns 3 m long and 3 mm in inner diameter. Helium was used as a carrier gas. The phases in the columns are molecular sieves 5A and Haysep Q.

Determination of the quantitative composition of gas mixtures was carried out by an external standard method (chromatograph was pre-set for each component of the gas mixture) :

$$C_i = k_i * S_i,$$

Where S_i is the concentration of the i- component in the gas mixture (vol.%), the calibration coefficient for the K_i- component (vol.% :(mV-min)), Si is the peak area of the i- component in the chromatogram (mV-min).

Processes are carried out in a flow reactor in the absence of water vapor at atmospheric pressure (carbonate conversion of methane) and in the presence (methane vapor carbonate conversion) in a ratio of 1: 1 CH_4: SO_2, volumetric feed rate 1000 -1 (V0) and process temperature 300 to 1050 Was carried out by modification to °C. The analysis of the initial and final products of the reaction was carried out on-line using gas chromatography. The volume of the catalyst was 6 ml, the duration of the process was 10-12 hours.

Contact time $t_{contact}$ (in seconds) is calculated according to the following formula:

$$\tau_{cont} = \frac{V_{cat} * 273}{F * (T_p + 273)} * 60$$

Where V_{cat} is the volume of the catalyst sample (ml), F is the volume (molar) flow rate of the reaction mixture, and Tr is the reaction temperature (° C).

The volume of the V_{cat} catalyst was determined according to the following formula.

$$V_{qat} = \frac{\pi * (D^2 - d^2)}{4} * h,$$

Where D is the outer diameter of the catalyst (cm), d is the inner diameter of the catalyst (cm), and h is the length of the catalyst (cm).The main parameters of the process of conversion of methane to carbon dioxide were determined by the following formulas:

$$X(CH_4) = \frac{F(CH_4)_0 - F(CH_4)}{F(CH_4)_0} * 100\%, \quad X(CO_2) = \frac{F(CO_2)_0 - FCO_2)}{FCO_2)_0} * 100\%,$$

CONCLUSION: Where X (CH_4) 0 and X (CO_2) are the conversion rates of methane and carbon dioxide (%), F (CH_4) 0 and F (CH_4) are the volumetric (molar) consumption of methane at the entrance to the reactor and at the exit, respectively (ml: min), P (CO_2) 0 and F (CO_2) - volumetric (molar) flow rate of carbon dioxide at the entrance and exit of the reactor (ml): min), F (CO) is the flow rate of carbon dioxide at the outlet of the reactor (ml: min), F (H_2) - volumetric (molar) hydrogen consumption at the output.

REFERENCES

1. Demidov DV, Rosenkevich MB, Sakharovsky Yu.A. Steam carbon dioxide conversion of methane as a method for producing synthesis gas of a given composition for small-scale production of methanol and synthetic hydrocarbons: Innovations in science: collection of articles. Art. by mater. VIII int. scientific-practical conf. Part I. - Novosibirsk: SibAK, 2012.

2. F. Gallucci, M. Van Sint Annaland, J. A. M. Kuipers, Autothermal reforming of methane with integrated CO2capture in a novel fluidized bed membrane reactor. Part 1: experimental demonstration // Top Catal., 2008, No 51, pp. 133–145.68.JensRostrup-Nielsen, 40 years in catalysis // Catalysis Today, 2006, No 111, P. 4–11.

3. Andrew P.E. York, Tian-cun Xiao, Malcolm L. H. Green, Methane Oxyforming for Synthesis Gas Production // Catalysis Reviews. 2011. P. 511–560.

4. D. Pakhare, J. Spivey,A review of dry (CO2) reforming of methane over noble metal catalysts // Chem. Soc. Rev.,2014, No 43, P. 7813–7837.

5. Mun-SingFan, A.Z.Abdullah, S.Bhatia, Catalytic technology for carbon dioxide reforming of methane to synthesis gas // ChemCatChem,2009, No 1, P. 192 –208.

6. J.-M.Lavoie, Review on dry reforming of methane, a potentially more environmentally-friendly approach to the increasing natural gas exploitation // Front. Chem., 2014, Vol. 2, No 81, P. 1–17.

7. Fayzullaev, N.I, Bobomurodova, S.Y, Xolmuminova, D.A Physico-chemical and texture characteristics of Zn-Zr/VKTS catalyst//Journal of Critical Reviews, 2020, 7(7), стр. 917–920

8. Omanov, B.S., Fayzullaev, N.I., Xatamova, M.S. Vinyl acetate production technology//International Journal of Advanced Science and Technology, 2020, 29(3), стр. 4923–4930

9. Fayzullayev, N.I., Umirzakov, R.R. To obtain acetone by spontaneous hydration of acetylene//ACS National Meeting Book of Abstracts, 2005, 229(2)

10. Fayzullayev, N.I., Umirzakov, R.R., Pardaeva, S.B.Study of acetylating reaction of acetylene by gas chromatographic method//ACS National Meeting Book of Abstracts, 2005, 229(2)

11. Fajzullaev, N.I. Kinetics and mechanism of reaction of catalytic hydrochlorination of acetylene//KhimicheskayaPromyshlennost', 2004, (1), стр. 49–52