

# GASIFICATION OF LOW-GRADE AND SALTY COALS

*L.V.Pashchenko, V.I.Saranchuk,*

*L.Ya.Galushko, T.G.Shendrik*

*Institute of Physical, Organic and Coal Chemistry of NASU,*

*70, R.Luxemburg str., Donetsk, 340114, Ukraine*

## Introduction

The goal of research is to find the possible ways of utilization of low-grade fuels, coals with high content of  $\text{Na}_2\text{O}$  ( $> 2\%$ ) and wastes after humic acids production called ent-huminated coals (EHC).

## Experimental

Experiments on gasification of low-grade and salty coals with carbon dioxide were carried out at the temperatures of 900, 1000 and 1100 °C. The gasification was carried out of carbonizates obtained by heating of coals without of air access in metal ampoule during three hours at the temperature 500°C. The content of carbon dioxide in argon stream was 30 %. The choice of carbon dioxide concentration was caused on its fluctuations in blast-furnace gas from 25 up to 30 %. Salty coals are referred to low-rank coals, the content of Cl-iones in the samples is 3.85-5.74 mg/g.

## Results and Discussion

It has been found the reactivity of coal carbonizates to carbon dioxide. The influence of alkaline treatment of coals on reactivity of solid carbonizates in the gasification process has been considered. It has been found that preliminary treatment of these coals with alkaline solutions leads to extraction of humates, to increasing of carbonizates yield, specific surface and practically full elimination of Cl-iones. The treatment of these coals with alkaline solution leads to increasing of carbonizates yield and specific surface. It is relates with extraction of humates because humates are caused the increasing yield of volatile matters for non-treated coals. During this process the increasing content of structure defects forms and leads to increase of carbonizates specific surface. The data of the Table show that the gasification rate of non-treated and salty coals is limited by the structure and composition of coal organic part but not by the Cl-iones content. It has been found that gasification rate constant of treated with alkaline solution low-grade and salty coals are in 2-10 times higher than non-treated coals. The increase of temperature from 900 up to 1100 °C leads to levelling of differences in gasification rate constants of different coals and coals treated by potassium hydroxide.

The formation of gases such as hydrogen, methane and carbon oxide takes place during the processes of carbonization and activation by  $\text{CO}_2$  of ent-huminated coals. The gases content stabilizes and becomes constant after 60-80 minutes. It is noted that at the process of EHC-Na carbonization (residues obtained by treatment of EHC by 1 % solution of NaOH after humates removal) the volume of obtained  $\text{H}_2$  is in 4 times larger and the volume of CO is in 1.5-2 times less than at carbonization of EHC-H (residues obtained by treatment of EHC-Na by 0.1 n solution of HCl for removal of  $\text{Na}^+$ ). As it is seen from Figure at the process of activation of the samples EHC-Na the volume of obtained CO is larger than at activation of EHC-H. The volumes of obtained  $\text{H}_2$  are approximately equal for two types of ent-huminated residues.

On our view large volume of obtained  $\text{H}_2$  at the process of EHC-Na carbonization connected with larger strength of intermolecular H-bonds in EHC-H in comparison with polarized C-C-bonds in oxygencontaining structures of EHC-Na. So at carbonization of the samples we have the formation of  $\text{H}_2$  from EHC-Na at first and CO from EHC-H. After evolution of  $\text{H}_2$  the carbonizates of EHC-Na are rich with oxygencontaining structures. So at the activation process samples EHC-Na give larger volumes of CO in comparison with samples EHC-H which give larger volumes of  $\text{H}_2$ . The specific surface of EHC-samples after activation by  $\text{CO}_2$  consists 17.6-34.2  $\text{m}^2/\text{g}$ . The increasing of activation temperature leads to increasing of samples specific surface.

## Conclusions

So the chemical peculiarities of raw material structure make decisive influence on the process of gases evolution, on the quantity and composition of gaseous products of activation process. It has been established that low-grade and salty coals in principle could be used as raw material for reception of reducing gases by the method of carbon dioxide gasification at the temperature of 1000 °C. The preliminary treatment of these coals by 1 % alkaline solution allows to extract the humates of alkaline metals and to increase the rate of gasification in 1,1-1,4 times.

**Table.** Rate constants  $K$  ( $\text{m}^3 / \text{kg c } 10^2$ ) of low-grade coals gasification by carbon dioxide

Samples	Temperature, °C		
	900	1000	1100
Lignite	0.47	1.97	3.57
Lignite treated by KOH	4.66	4.79	5.02
Salty coal, layer $C_2$	0.61	1.62	3.38
- " - treated by KOH	3.56	3.97	4.63
Salty coal, layer $C_1^{4a}$	1.13	2.36	3.81
- " - treated by KOH	2.19	3.21	4.26

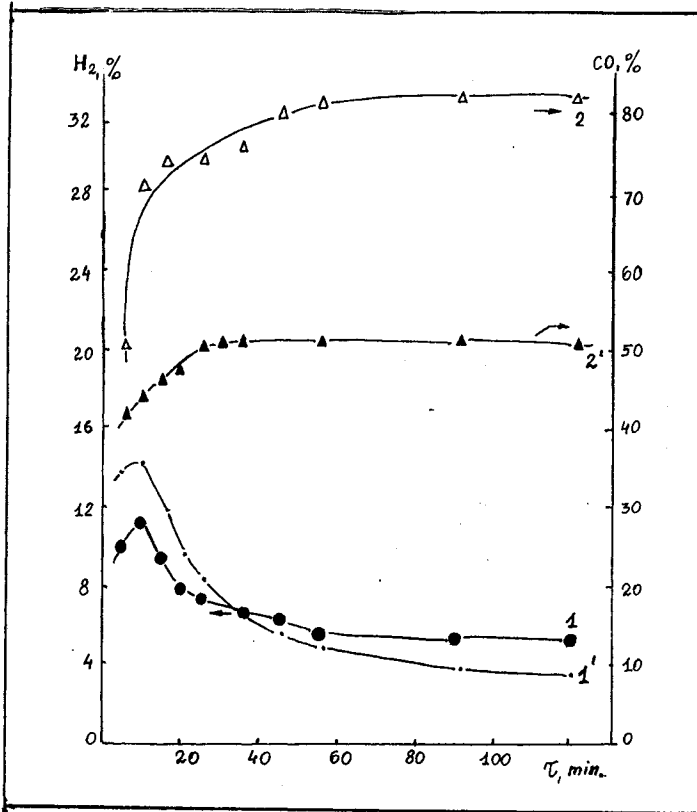


Figure. Kinetic curves of  $H_2$  (1, 1') and  $CO$  (2, 2') evolution at the activation of carbonizates with carbon dioxide ( $t=800^\circ C$ ):  
 1,2- EHC-Na, seam  $C$ ; 1',2'- EHC-H, seam  $C_4^{3-3}$ .