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Supercritical Water as NanoMedia for Gasification of Brown Coal-Water Suspension

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Comparison of the conditions and operation of the processes of supercritical and steam gasification and obtained products shows that these processes are not the same (Table 1). Pure carbon material – graphite – in water at supercritical pressure wasn't converted in the temperature range from 300 to 500 °C. Only while a combination of organic, mineral and water components at supercritical pressure coal was gasified. It allows to predict the effect of mutual stimulation (inter amplification) of reagents in supercritical coal-water conversion. Therefore, the mechanism of steam gasification to supercritical isn't usable.

Table 1

Parameter	***Supercritical Gasification***	***Steam Gasification***
Raw	Brown coal, water suspension	Coal, steam
Temperature, °C	330-450	800-1000
Pressure, MPa	24-30	Up to 2
Medium	Supercritical water	Superheated steam
Catalysts	Compounds of alkali and alkali earth metals	
Products	Combustible gas, water phase, solid	Combustible gas, organic phase (alkanes), aromatics
Gas content	H_2, ~~CO~~, **CO_2**, CH_4, C_xH_y, N_2, O_2	H_2, **CO**, CO_2, CH_4, C_xH_y, N_2, O_2

This is due primarily to the fact that the transition in the supercritical state is following with water restructuring. Under pressure 24-30MPa water heating above 170°C leads to destroying of hydrogen bonds net of 150-200 molecules. "Flickering" system is formed by water clusters of one to ten water molecules [1] ranging in size from **0.9 to 6 nm**. The clusters of two-five molecules at subcritical temperature dominate of non-bonded molecules. In the supercritical region unbound molecules are dominated (up to 75 %) [1]. Both the organic and mineral substances of brown coal interact with clusters of supercritical water. ORGANIC - through the formation of dipole-inductive and dispersive associates and MINERAL – by ion-inductive interactions with the formation of ion associates. Thus formed associates were responsible for the further transformation of coal.

1. *S.V. Churakov, A.G. Kalinichev.* Size and Structure of Molecular Clusters in Supercritical Water // Zhurnal Structurnoy Chimii. - 1999.**-40.-**P. 673-680.