Institute for High Temperatures Russian Academy of Sciences

Development of new technologies for using biomass as a fuel

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The purpose of work

Development of new complex technologies of biomass processing with receiving of various sorts of ecologically safe and high-calorific power fuel and raw material for industrial applications

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Why is it necessary to develop complex technologies of fuel production from biomass in Russia?

- The share of Russia in peat reserves is about 162 billion tons that is the first place in a world (near one third of world resource).
- 23 % from total amount of woods in the world are at Russian's territory.
- It is technically possible to use in power industry of our country annually not less than 1000 million ton of biomass, including waste wood products, waste from woodworking industry and waste products of an agricultural production

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In many areas of our country the usage of local kinds of fuel appears economically more favorable, than traditional fossil fuels

In the table cost of thermal energy in the Kostroma area in 2004 is presented depending on a kind of fuel:

Kind of fuel	**Average price, ruble/Mcal**
Natural gas	388,0
Imported Coal	832,6
Residual oil (mazut)	682,4
Firewood, wood chips	389,9
Peat	349,0

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Main directions of investigations:

- High-temperature noncatalytic pyrolysis of biomass,
- Low-temperature catalytic pyrolysis of biomass,
- Technologies of joint processing vegetative waste products and organic fuels

During the biomass pyrolysis process the following valuable products can be received: high-calorific power gas, liquid fraction for manufacturing motor fuels and solid materials with high carbon contents which can be received in the form of activated coal, sorbent, coke, household fuel, pure carbon raw material for various industrial applications.

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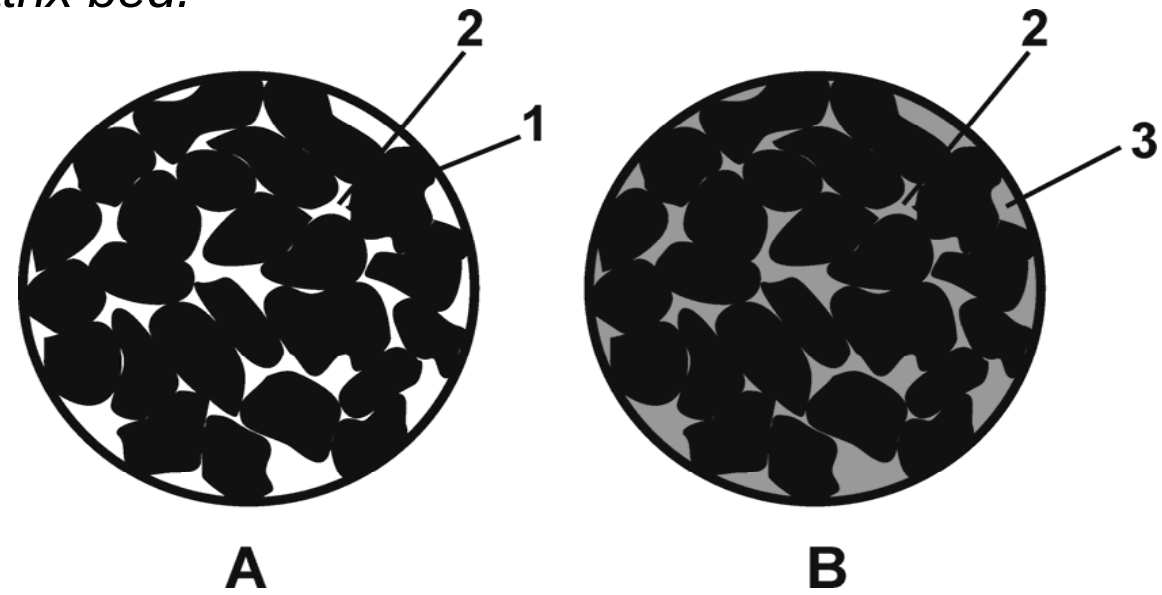
At the first stage thermal structure of charcoal is formed. At the second stage thermal decomposition of natural gas is carried out in this porous matrix bed.



A – the initial structure of charcoal; B –the same structure after stuffing with pyrocarbon. 1 - particles of dispersed carbon, 2 – inner pores free and stuffed, 3 – the exterior pores stuffed with pyrocarbon structure.

Dry wood of different sorts has practically identical composition: carbon, on the average, - 49 %, hydrogen - 6 %, oxygen - 44 %, nitrogen - 0,1-0,3 % and 0,2-0,8 % of ash.

The developed process allows to receive high-quality carbon composite which consist from wood carbon and carbon from natural gas. It can be used as high calorific ecologically safe energy carrier and raw material for various branches of industry.

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Big experimental facility for joint processing of natural gas and carbon containing wastes

Heat and power plant on the base of gas engine for using gaseous reaction products

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CHARACTERISTICS OF THE ACTIVATED COAL

Specific surface - 900-1450 m^2/g,

- from them micropores with a diameter - 4-6 angstroem - 60% of volume;

- mesopores with a diameter- 12-100 angstroem - 40 % of volume.

- The price of activated coal БАУ (600-700 m^2/g) - 70 thousand rubles for ton ($ 2700).

- From the conclusion about the results of a specific surface study of the activated coal received by using the technology of the Institute for High Temperature Russian Academy of Science, « … some samples submitted for tests, are a prototype of molecular sieve … »

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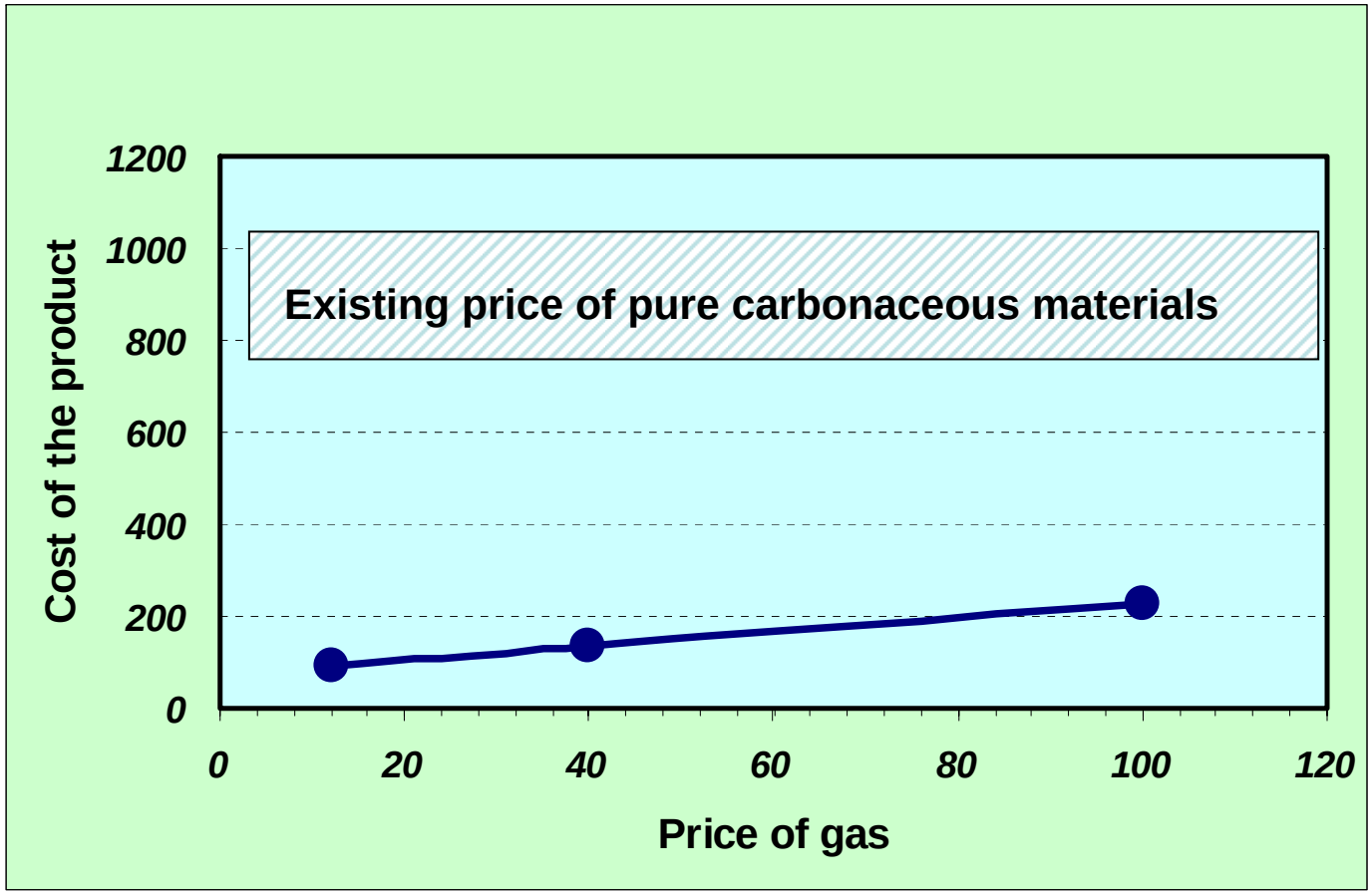
The characteristics of reaction products produced by means of joint processing of wood waste and natural gas

- **Pure carbon materials**
- **Moisture content,% -0,24**
- **Volatile, -% - 1,04**
- **Ash, % - 1,23**
- **Sulphur, - % - 0,02**
- **C,% - 97,84**
- **H, % - 0,22**
- **Calorific value, MJ/kg - 32,95**
- **Density, g/cm^3 - 0,76**
- **Gaseous reaction products:**
- **Hydrogen – 78-80%, the rest – not decomposed methane**

Cost of the product ($)



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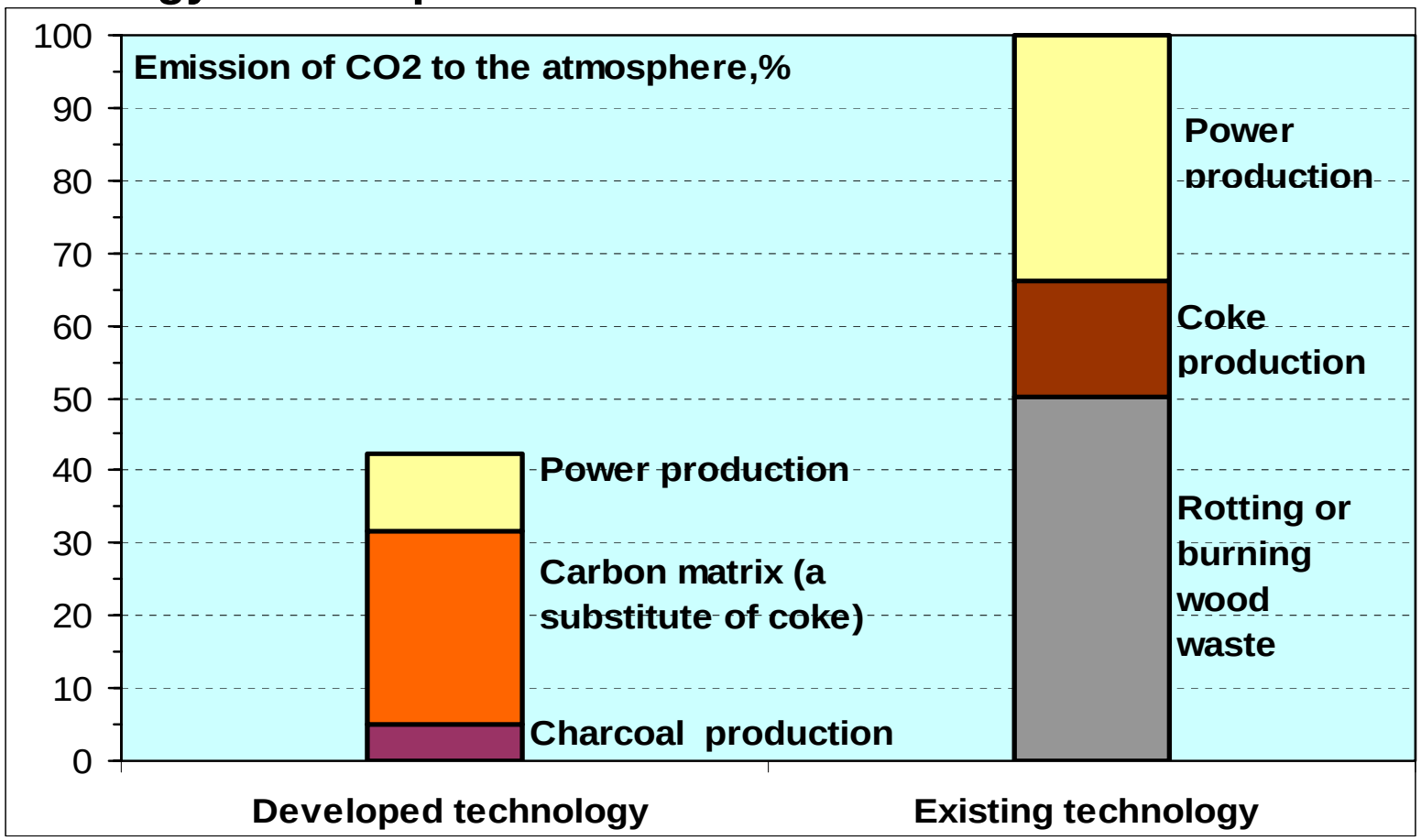
Comparison of CO2 emission of developed technology and existing technology of coke production



Conclusion - 1

The products of Biomass Pyrolysis

- **bio-gas**
- **bio-oil**
- **solid fuel, activated coal, coke, sorbents**

Depends on the regime parameters of the process the calorific value of bio-gas is 15-17 MJ/m^3, bio-oil – up to 30 MJ/m^3, the solid products – up to 32 MJ/m^3. The process of joint processing of biomass and natural gas allow to produce gas mixture with hydrogen content in average 80%.

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Joint processing of biomass with natural gas (fossil fuel) will allow to decrease carbon dioxide emission to the atmosphere. Hydrogen production for power units simultaneously with pure carbon materials for industrial technologies allowed to carry out this process economically justified without creating a global system of CO_2 storage

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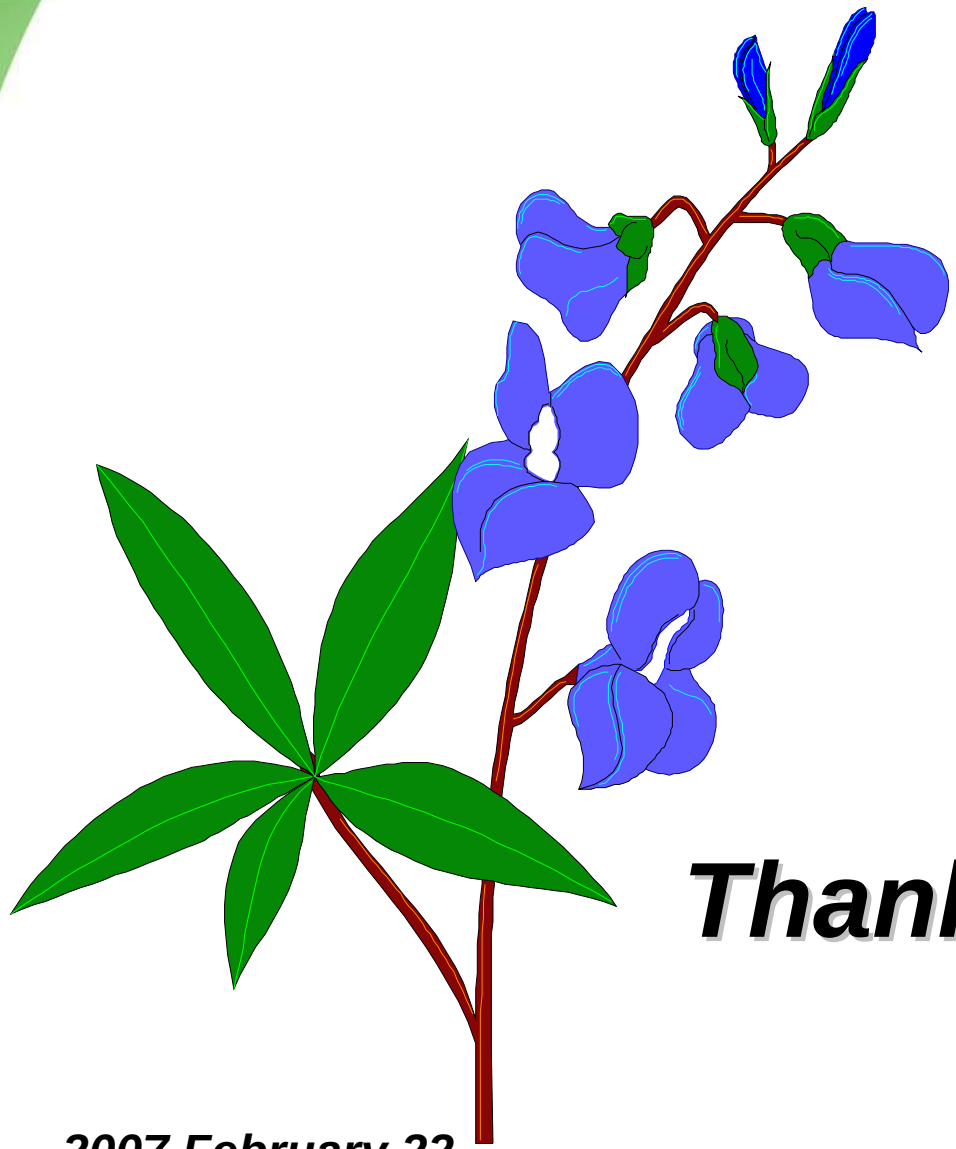
CONCLUSION - 2

Joint processing of biomass with natural gas allow to produce a set of valuable products including hydrogen. Hydrogen energy (based on production hydrogen from natural gas) may be considered as part of the total problem connected with development of new methods and technologies of complex processing of biomass and natural gas with simultaneously production of hydrogen and carbonaceous materials. The above described technology is one of the examples of complex approach.



Thank you for attention

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