

Replacement of fossil fuels by forestry and agricultural residue in pyrometallurgy

Presenter: Iryna Fedorenko

Physical and Technological Institute
of Metals and Alloys
National Academy of Sciences of Ukraine (NASU)

34/1 Vernadskogo Ave., Kyiv, 03680, Ukraine
vlads@visti.com



KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY



Projekt współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego

Summary

- It was calculated that application of the heat-generating bioresidues annually formed in Ukraine should save 5.78 mln t of coal.
- The total balance of CO₂ emissions to the environment will be reduced. The limited availability in Ukraine of biomass-fired heating boilers and stoves hinders prompt realization of this option favorable for environment.
- We propose to take advantage of pyrometallurgical equipment that efficiently operates in Ukraine.
- Thermoanalytical measurements (DTA/TG) of bioresidues was made for determination of their behavior during pyrometallurgical processes

Objective

Promote the use of diverse and sustainable energy bio-resources in metallurgy, displacing fossil fuels as much as possible by development of pyrometallurgical technologies

Its vision

Partial replacement of the traditional solid fossil fuel by agriculture and forestry residues that

- **produces high quality steels and ferroalloys with lower content of sulphur, phosphorus, boron;**
- **reduces dependence of metallurgy on expansive and scarce coke and anthracite;**
- **provides reduced greenhouse gas emissions;**
- **creates economic advantages**

Potential of Ukraine in basic agricultural crop and forestry residues as biofuel

Residues	Annual amount of generated residues, mln. t	Net calorific value (kJ/kg)	Potential for replacement of coal by the residues, mln. t
Straws of cereal crops	6.17	10500	2.21
Stems of maize	2.79	12500	1.19
Sunflower seed husks	0.66	16000	0.36
Forestry felling residues, thinned, wood and wood processing waste	4.29	13800	2.02

The practical application has showed several positive features

- Availability of equipment that operates at elevated temperatures.
- Very often the solid biofuel is free of some admixtures those are detrimental in the produced metals and alloys.
- Sufficient number of workers involved in the current production process may distribute evenly their new duties connected with additional manual operations those may arise.
- Generation during combustion of residual char. It takes important part in the reduction pyrometallurgical processes and may replace some expensive and scarce reductants.

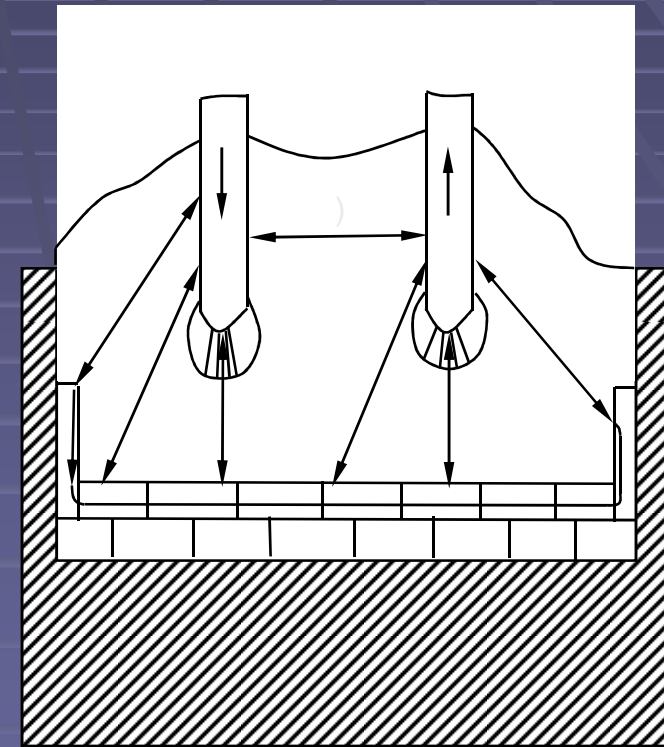
Forestry residues in ferrosilicon and silicon production

The greatest problem in usage of the solid residues is larger content of combustible volatiles.

76.4% of volatiles are present in sunflower husks

The method of solid biofuel introduction into the charge is critical for getting highest possible utilization of heat generated during its combustion.

It has been found out that among optimal processes is 65% ferrosilicon production in a sealed submerged arc furnace 22.5 MVA.



Increase of electric support of the charge and correspondent facilitation of a melting operation

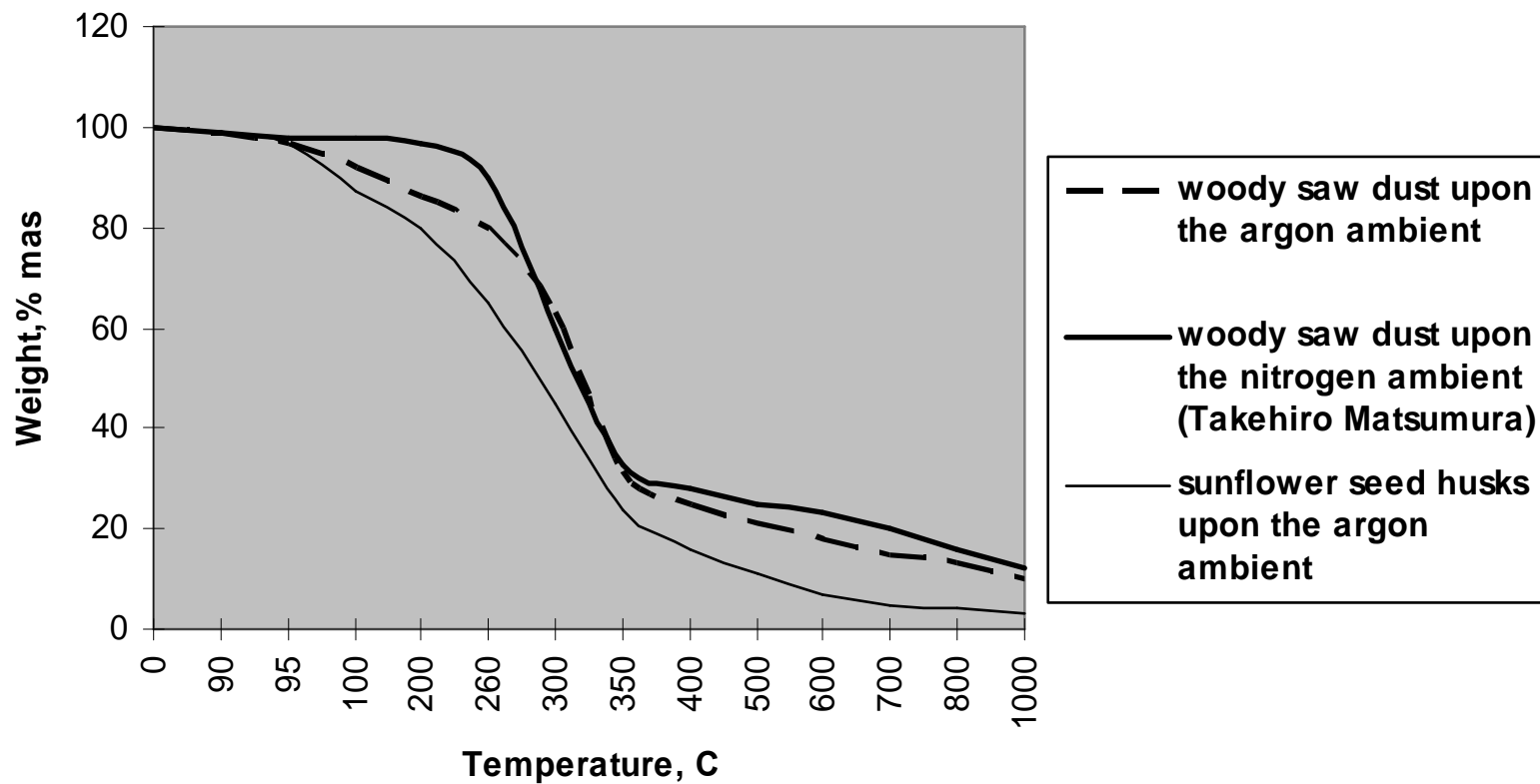
Rice hulls in steelmaking production

Content of admixtures in rice hulls of different origins

	Al	B	Ca	Fe	Mg	Mn	Na	P	Ti	Cu	Zn
Ukraine, Kherson oblast	0.0009	0.0004	-	0.02	0.0001	0.01	0.002	0.0008	0.00001	0.0005	0.00001
Russia, Kuban	0.02	0.001	0.04	0.09	0.3	0.15	0.02	Traces	0.002	0.002	-

The annual amount of the rice hulls generated in Ukraine is about 100,000 tons. This is quit enough to supply the domestic steelmaking by the high purity exothermic insulator. It is mostly used for insulation for several hours of steel ladles up to 350 tons in basic oxygen steelmaking plants and up to 120 tons in continuous casting process

Thermogravimetric curves of woody saw dust and sunflower seed husks upon the inert ambient



Conclusions

- ❖ The great number of the heat-generating biomass residues is formed in our country.
- ❖ About 10% of coal annually mined in Ukraine should be replaced by the residues.
- ❖ The easiest way of realization of this option is replacement of fossil fuel in pyrometallurgical processes those run at the high temperature installations. The forestry residues can efficiently substitute for coke at ferrosilicon and metallurgical grade silicon production in electric furnaces.
- ❖ The produced metal has lower phosphorus content. They are used during metal keeping for several hours in steel ladles during basic oxygen steelmaking and continuous casting processes. The heat generation during smouldering of the hulls takes place in this procedure. This effect reduces consumption of natural gas.

Thank you for your attention



KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY



Projekt współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego