



**BAUXITE RESIDUE  
VALORISATION AND  
BEST PRACTICES  
CONFERENCE**

**Leuven**

**5-7 October 2015**

**EXPERIMENTAL INVESTIGATION  
ON RECOVERY OF Fe-Ni ALLOY  
FROM BAYER RED MUD AND  
LATERITE NICKEL**

***JIANMIN ZENG***

***GUANGXI UNIVERSITY***

This experimental work aims to

1. Extract Fe alloys from red mud and laterite nickel by carbothermic reduction, and
2. use this alloys directly to shape investment castings with different compositions and various properties, so as to reduce production cost.

# Process flow chart

Bayer red mud



Laterite nickel



Coke powder



pelletizing



Carbothermic  
Reduction in EAF

Fe-Ni alloy

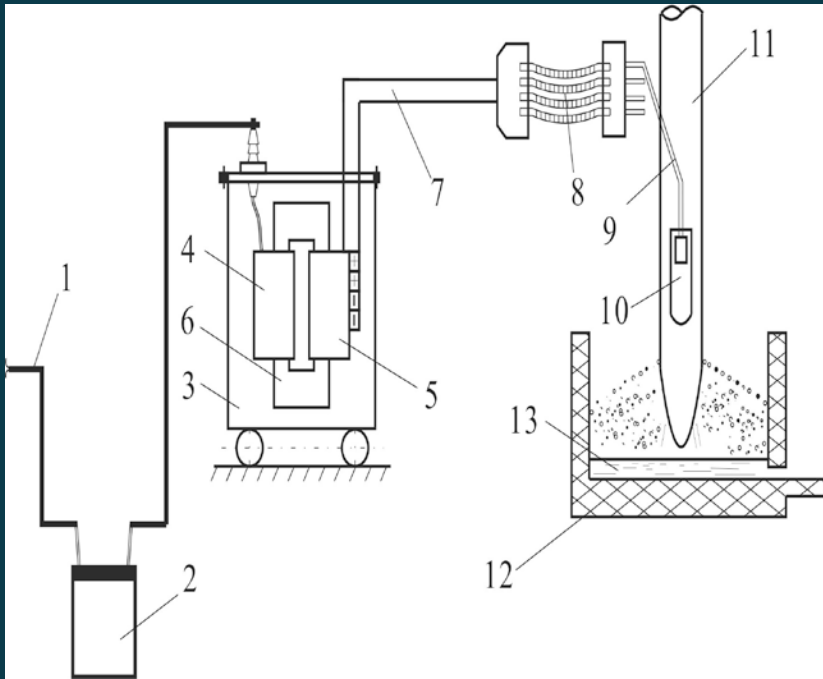


Slag

Production of  
castings

Additives for  
concretes

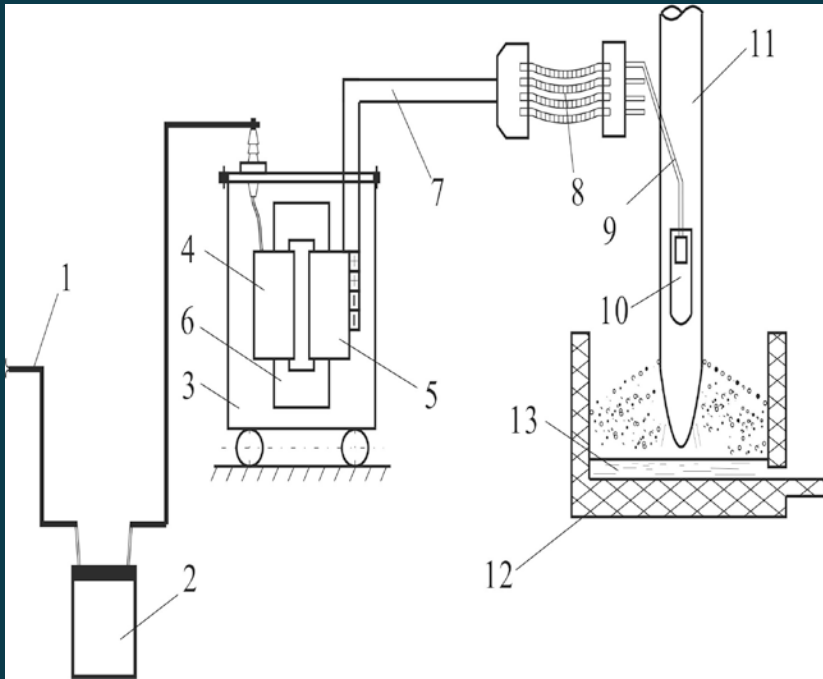
# Electric Arc Furnace



**Schematic of melting in electric arc furnace (EAF)**

**Photo of the EAF during carbothermic reduction**

# Electric Arc Furnace



**Schematic of melting in electric arc furnace (EAF)**

**Photo of the EAF during carbothermic reduction**

# Chemical composition (mass %)

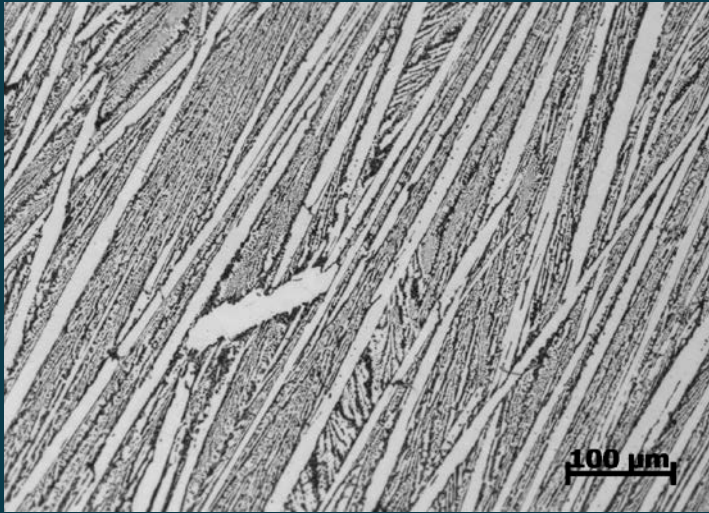
materials	Fe <sub>2</sub> O <sub>3</sub>	NiO	TiO <sub>2</sub>	Cr <sub>2</sub> O <sub>3</sub>	MnO
Red mud	35.30	0.001	4.90	0.31	0.17
Laterite	45.28	1.09	0.12	2.25	0.97
materials	Al <sub>2</sub> O <sub>3</sub>	CaO	SiO <sub>2</sub>	Na <sub>2</sub> O	MgO
Red mud	18.48	16.20	11.32	8.24	0.39
Laterite	7.36	0.29	5.08	0.88	0.45

# Fe-Ni alloy recovery rate %

Coke %	Total Recovery	Fe	Ti	Ni	Cr
20	70.13	71.22	20.13	56.45	45.39
25	74.87	73.24	25.34	72.36	58.45
30	82.16	78.61	37.45	80.56	52.85
35	88.95	82.13	48.69	94.98	56.46

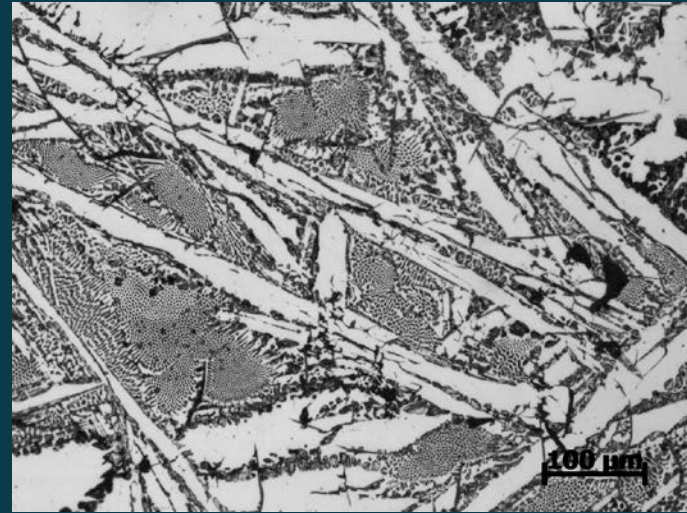


C20



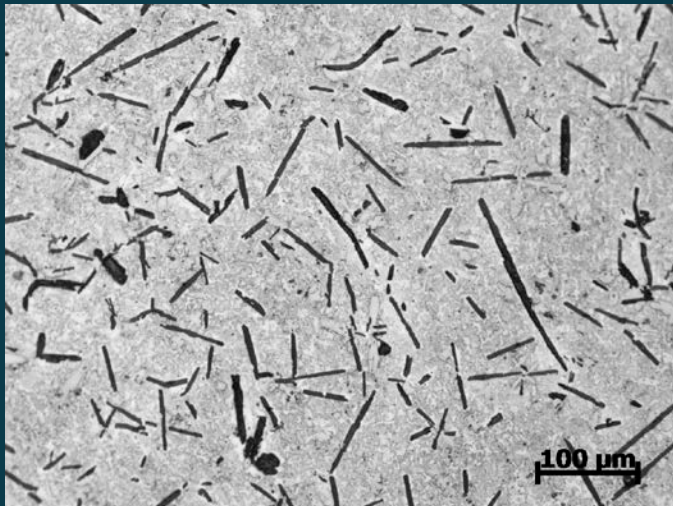
**Cementite + retained austenite**

C25



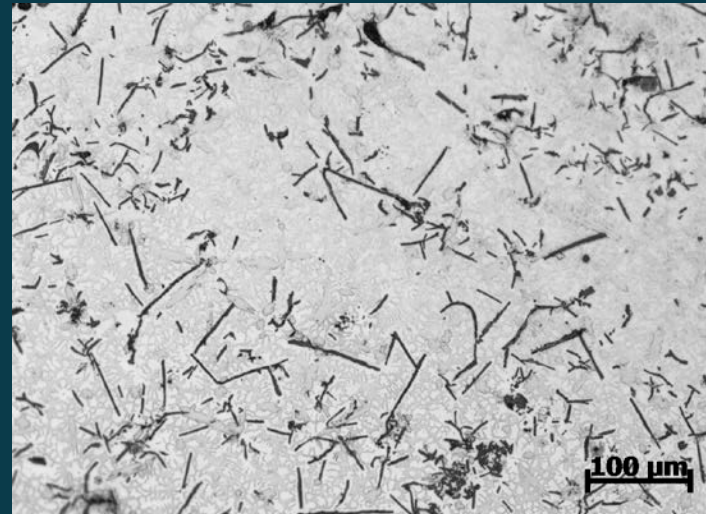
**Cementite + ledeburite**

C30

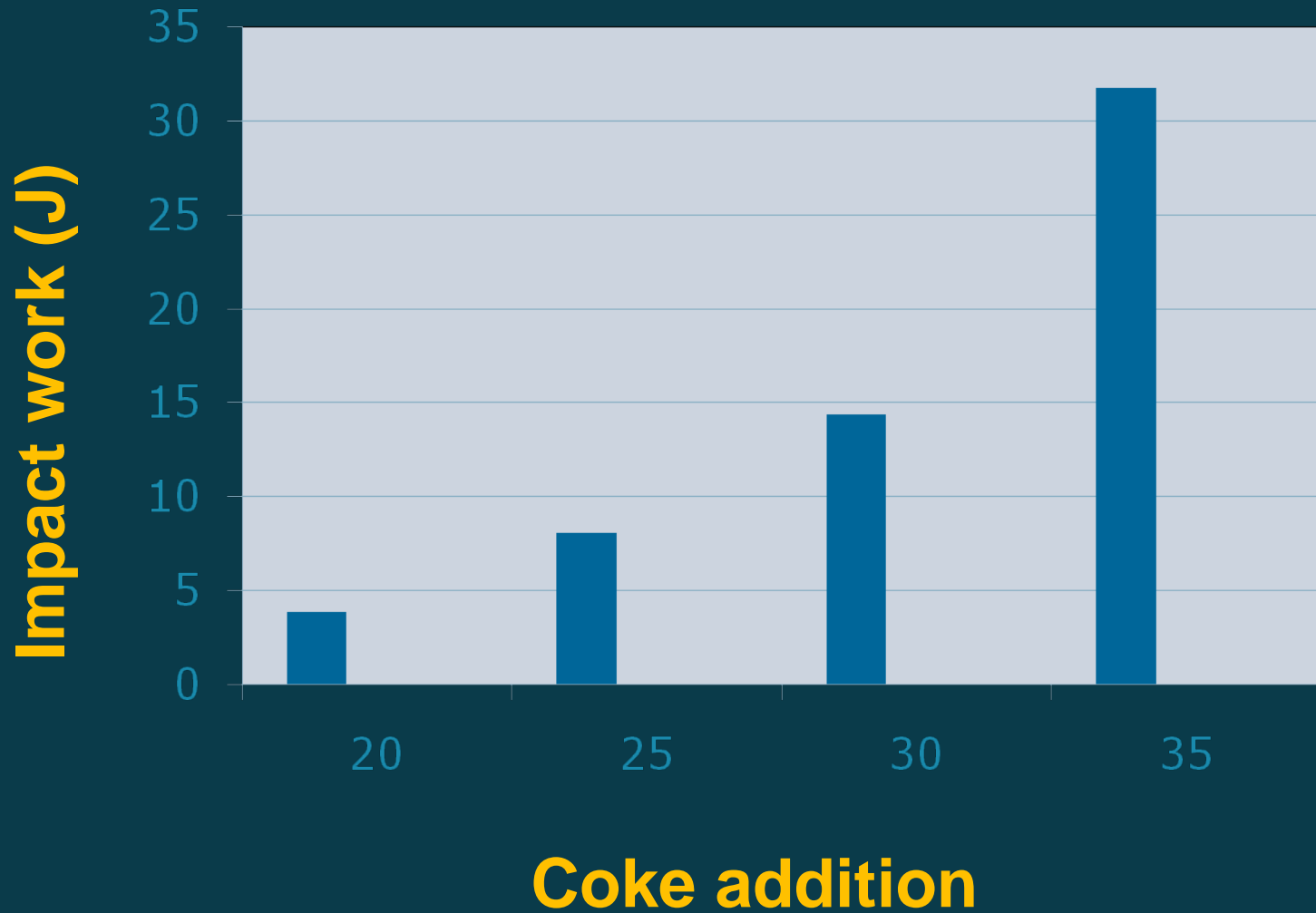


**Graphite + ledeburite**

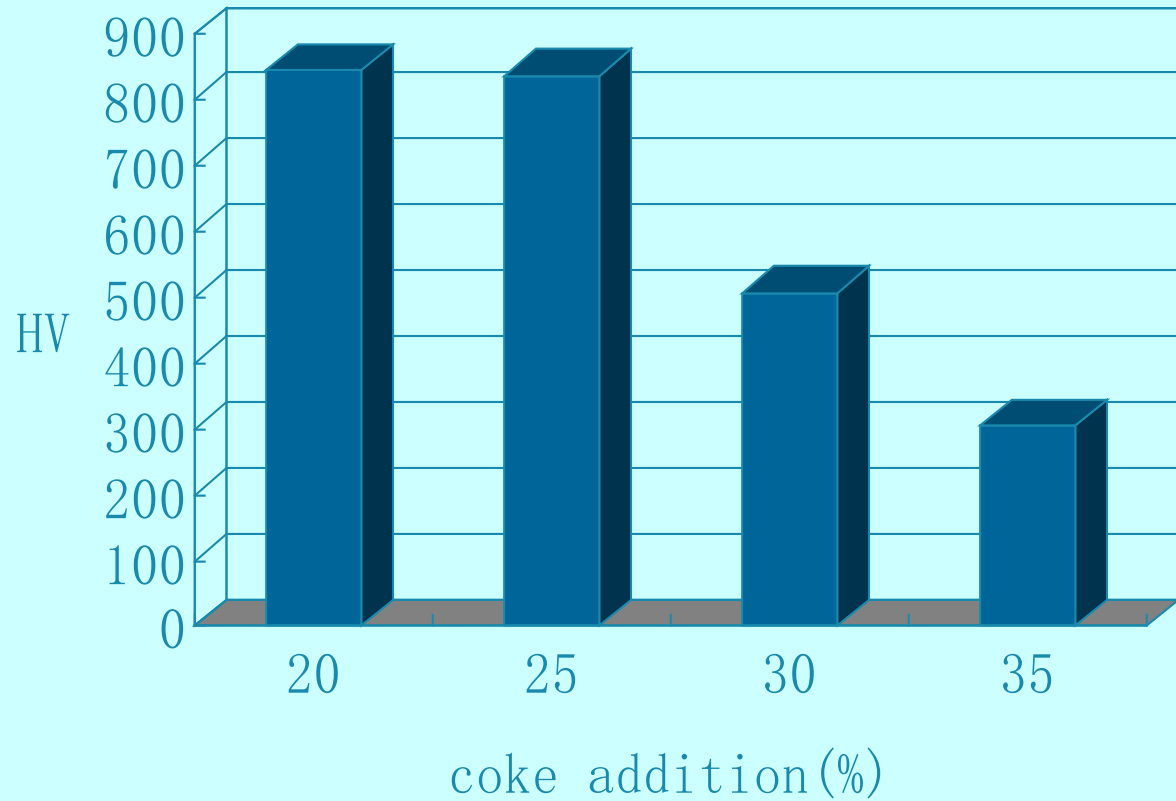
C35



**Grey iron**

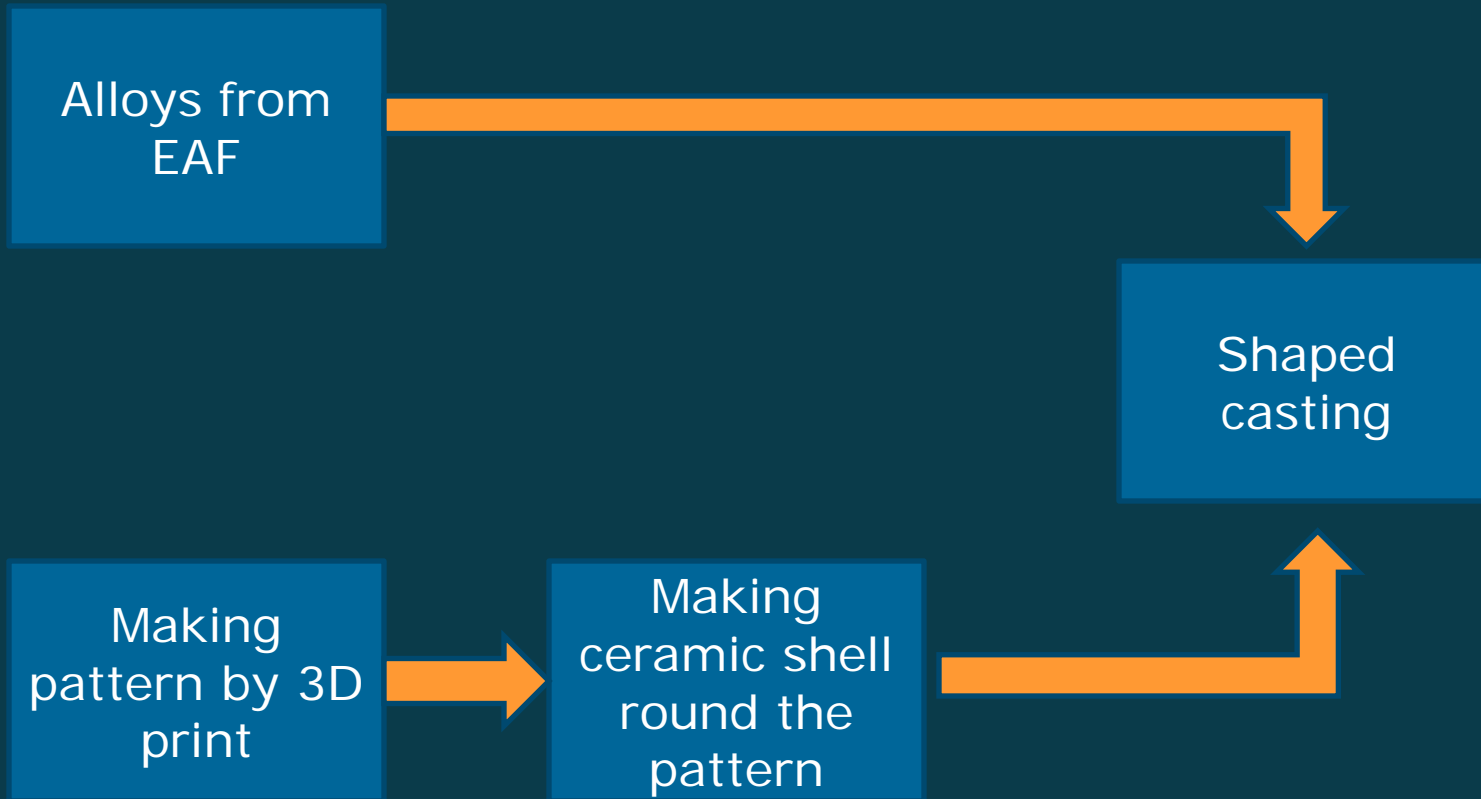


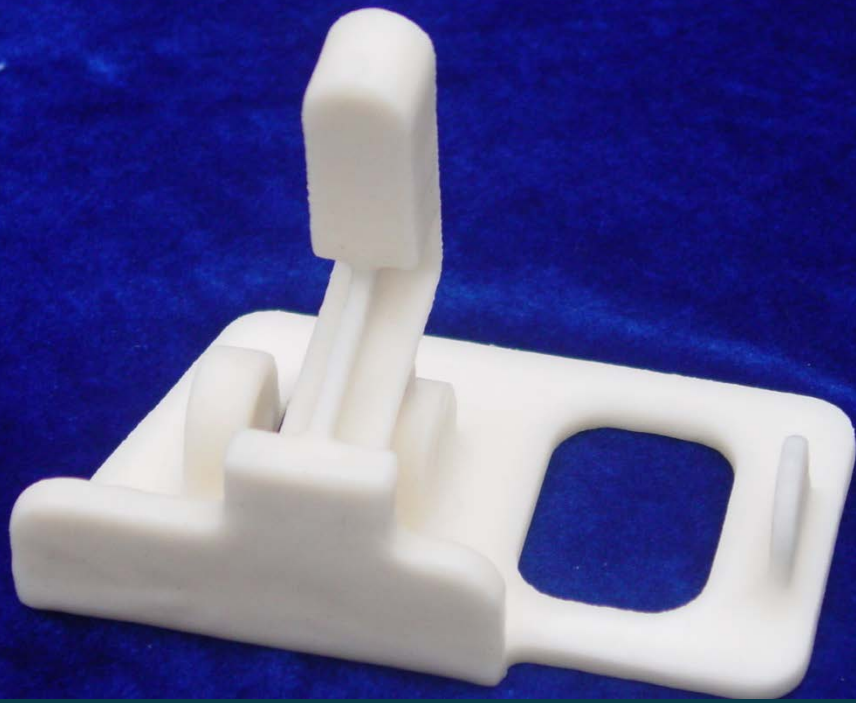
**Coke content and impact work**



**Coke content and hardness**

# manufacturing Investment casting using the alloys recovered from red mud and laterite nickel





The pattern was made by 3D print, using a starch powder which will be burn off after the ceramic shell has been shaped.

The final casting with different compositions can be produced by changing the ingredients and coke addition



# Conclusions

1. By carbothermic reduction, Fe-Ni alloys along with other elements can be recovered from bayer red mud and laterite Nickle.
2. Investment castings with different chemical compositions and different mechanical Properties can be cast directly from alloys Recovered from red mud and laterite Nickle, lowering the production cost greatly.

**Our experimental work is only preliminary and  
We hope to seek cooperation with you!**

**Thank You !**

