11th Scientific / Research Symposium with International Participation
„Metallic and Nonmetallic Materials“ Zenica, B&H, 21-22. April 2016.

ALTERNATIVE STEEL PRODUCTION DIRECT REDUCTION PROCESSES MIDREX DIRECT REDUCTION AT: ARCELORMITTAL HAMBURG

Dr. Mohammad Safi
ArcelorMittal Hamburg
Dradenaustraße 33, 21129 Hamburg, Germany

1. FROM IRON ORE TO STEEL

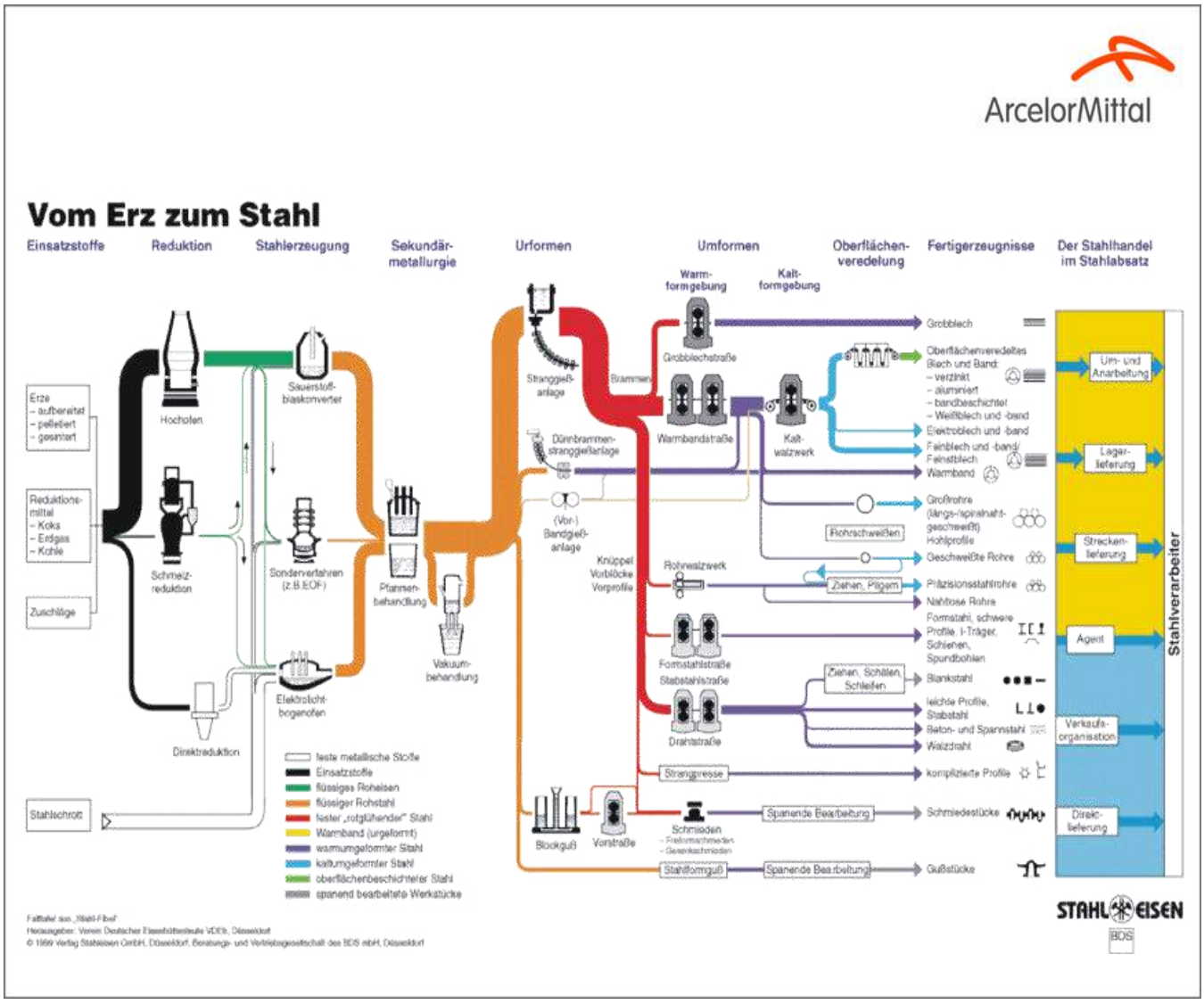


Fig. 1. From iron ore to steel

2. COMPARISION OF BF AND DR

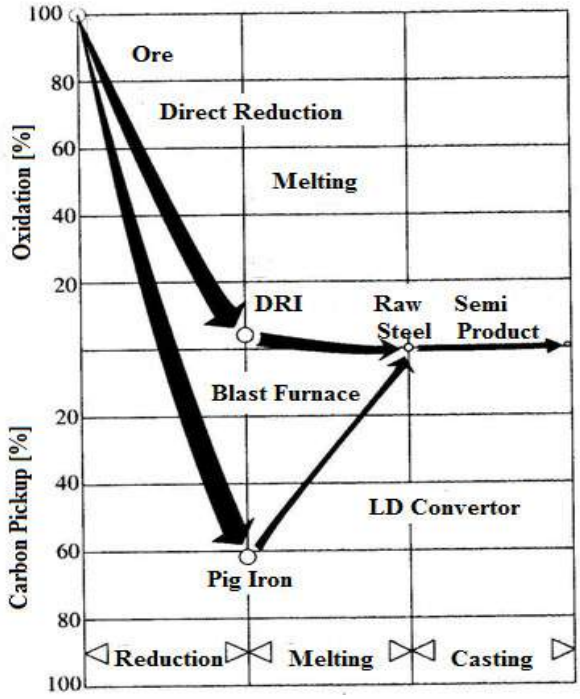


Fig. 2. Comparision of BF and DR

3. ARCELORMITTAL HAMBURG

Fig. 3. ArcelorMittal Hamburg

4. PRODUCTION FLOW

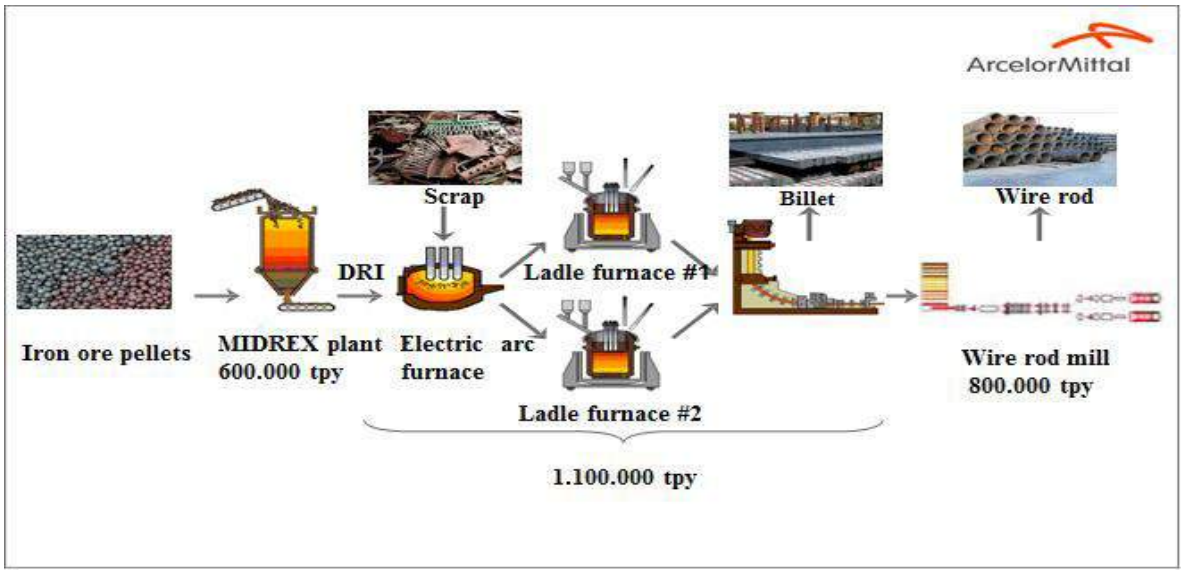


Fig. 4. Production flow

5. WIRE ROD SHIPMENT (2015)

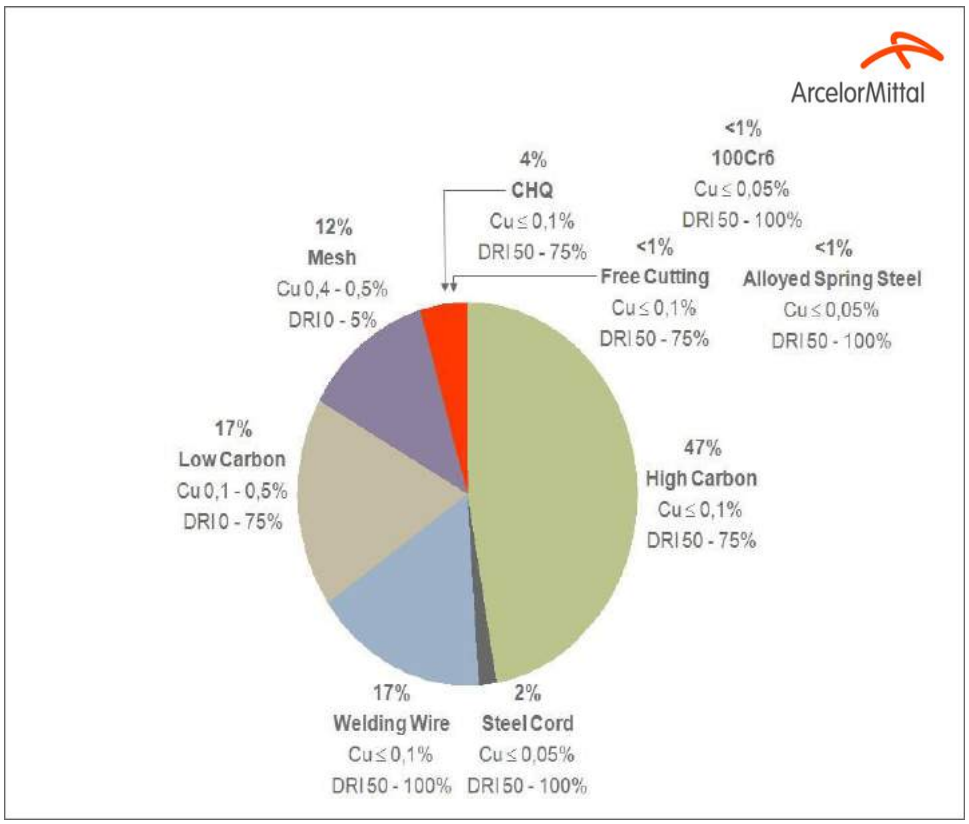


Fig. 5. Wire rod shipment (2015)

6. APPLICATION FIELDS

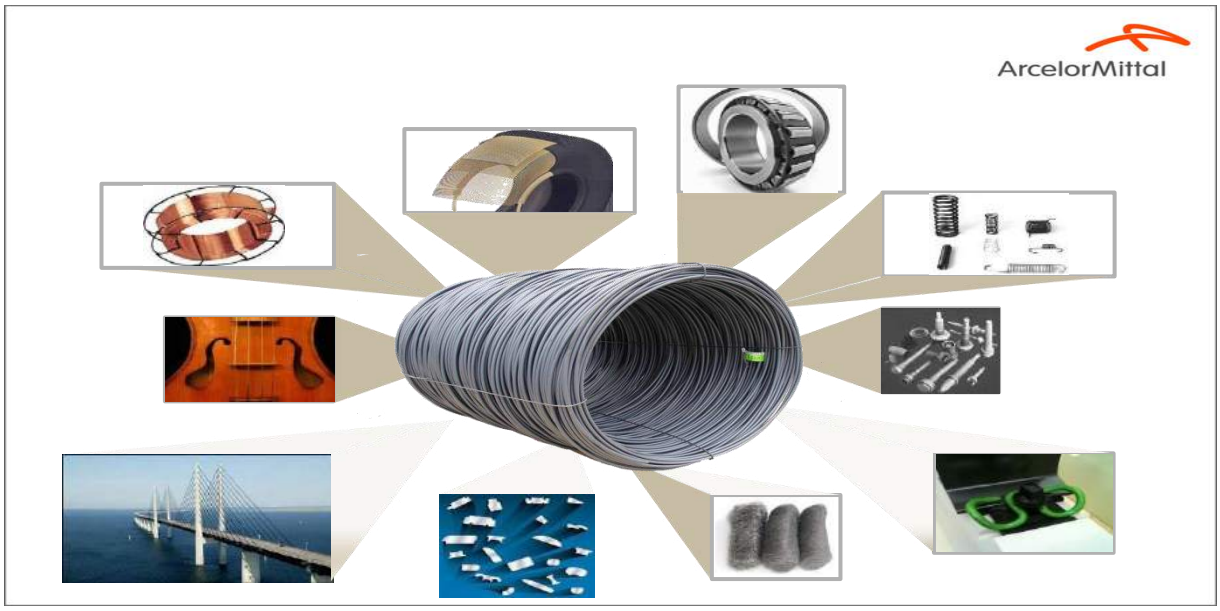


Fig. 6. Application fields

7. DIFFERENT DR PROCESSES

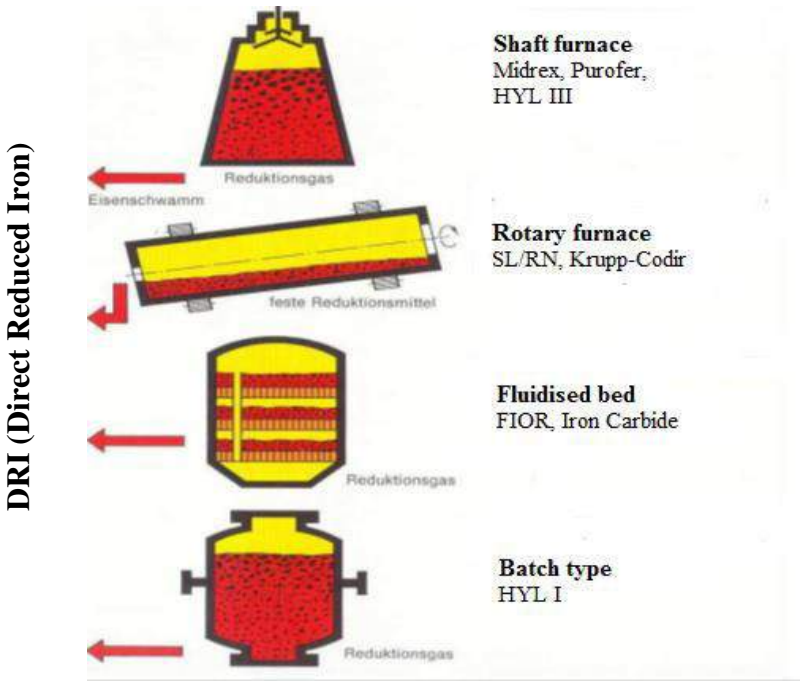


Fig. 7. Different DR processes

8. WORLD DRI PRODUCTION BY PROCESS

Fig. 8. World DRI production by process

9. WORLD DRI PRODUCTION BY REGION

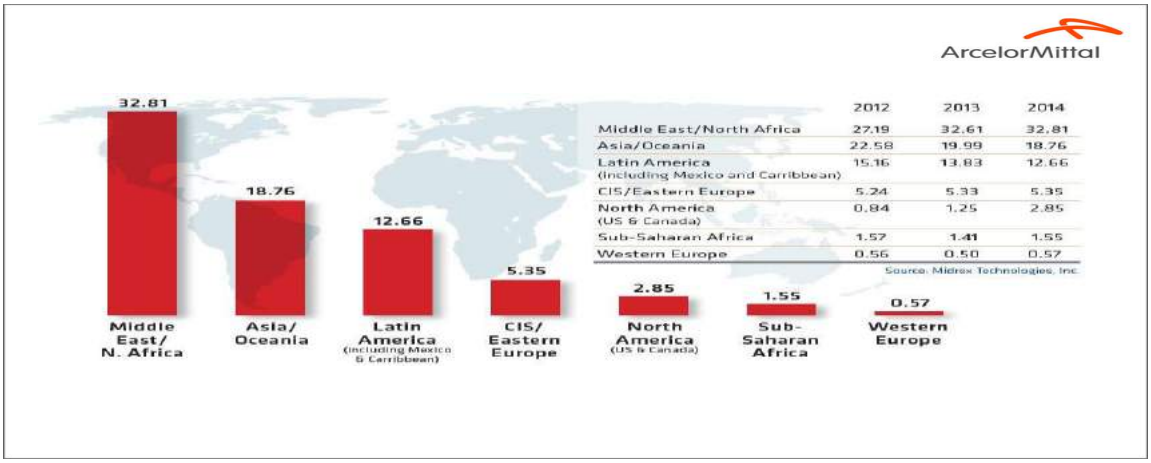


Fig. 9. World DRI production by region

10. MIDREX PROCESS FLOW SHEET

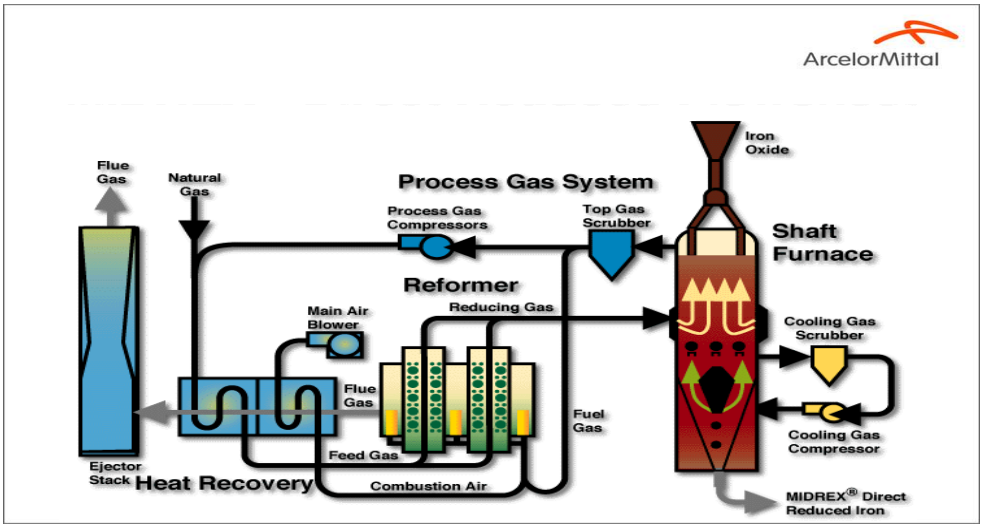


Fig. 10. Midrex process flow sheet

11. CHEMICAL REACTIONS

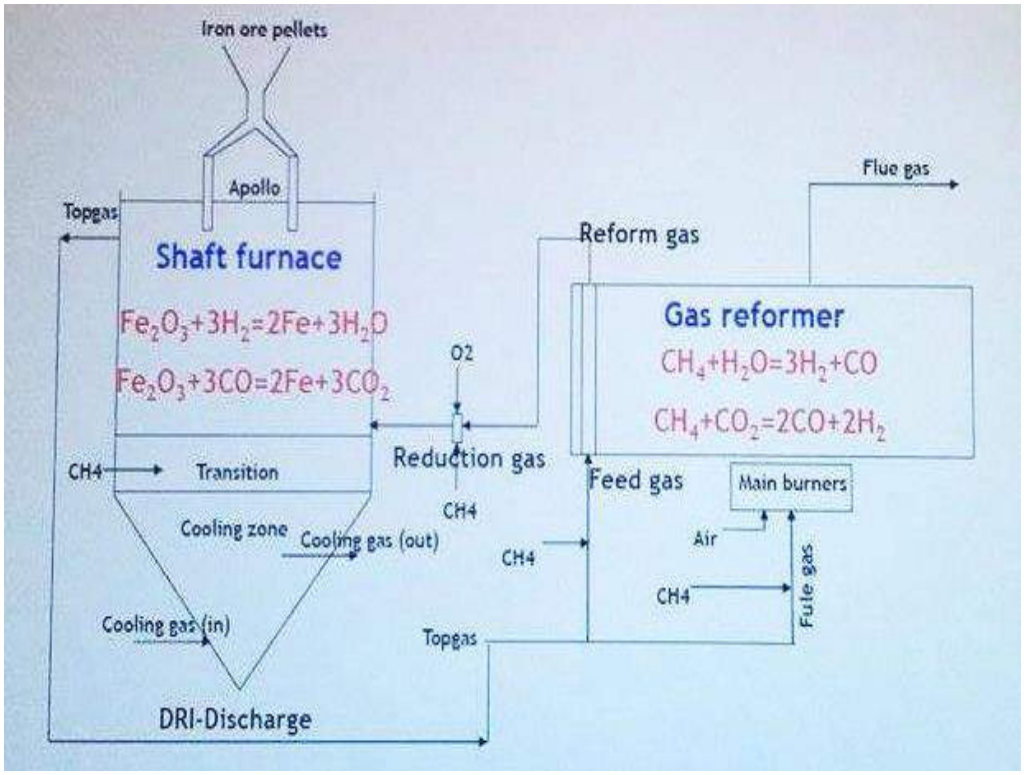


Fig. 11. Chemical reactions

12. QUALITY OF DRI

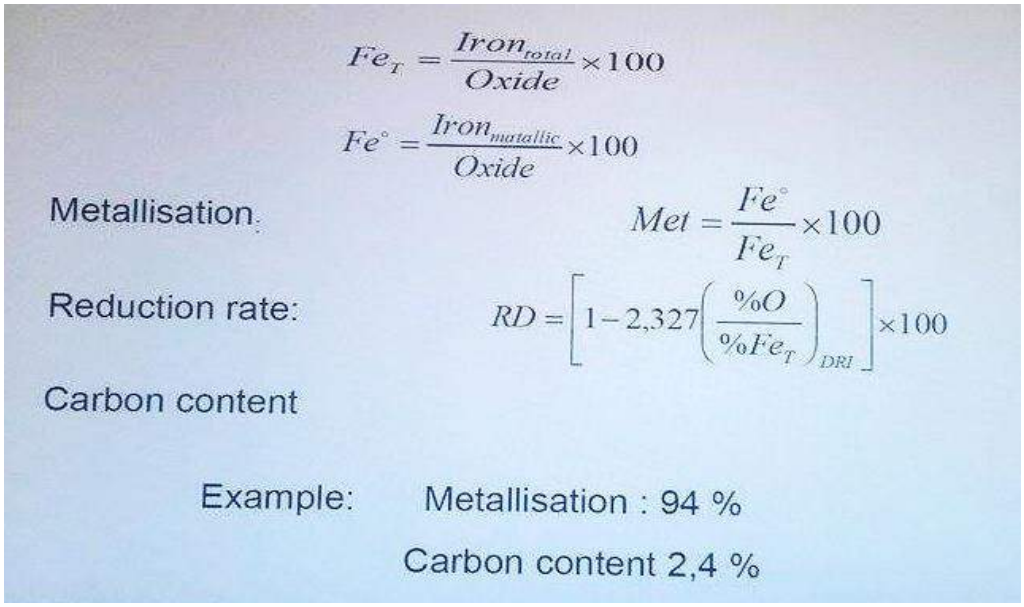


Fig. 12. Quality of DRI

13. SHAFT FURNACE

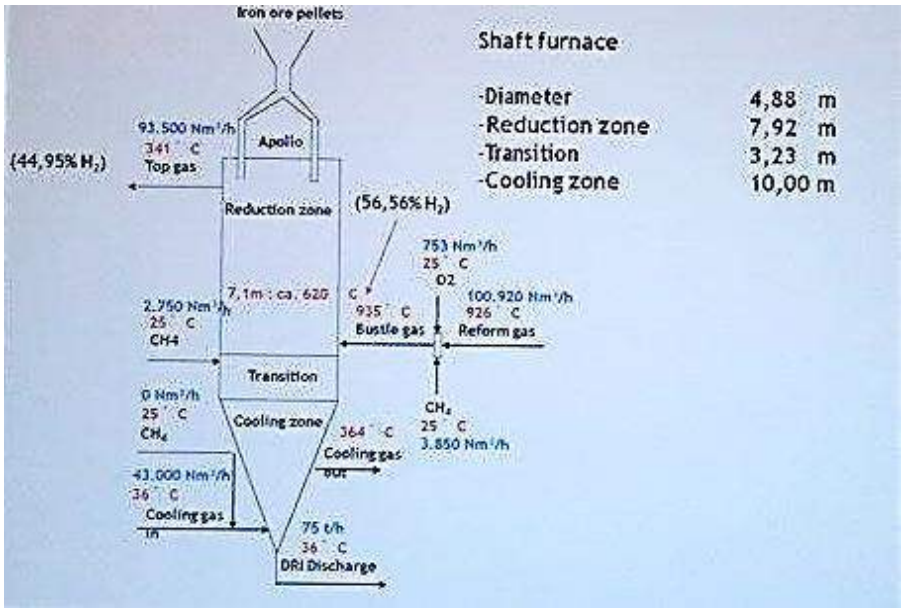


Fig. 13. Shaft furnace

14. BUSTLE - AND TOP GAS TUBES

Fig. 14. Bustle - and top gas tubes

15. BUSTLE GAS RING

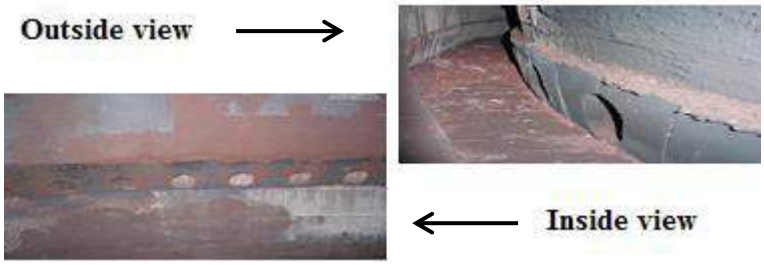


Fig. 15. Bustle gas ring

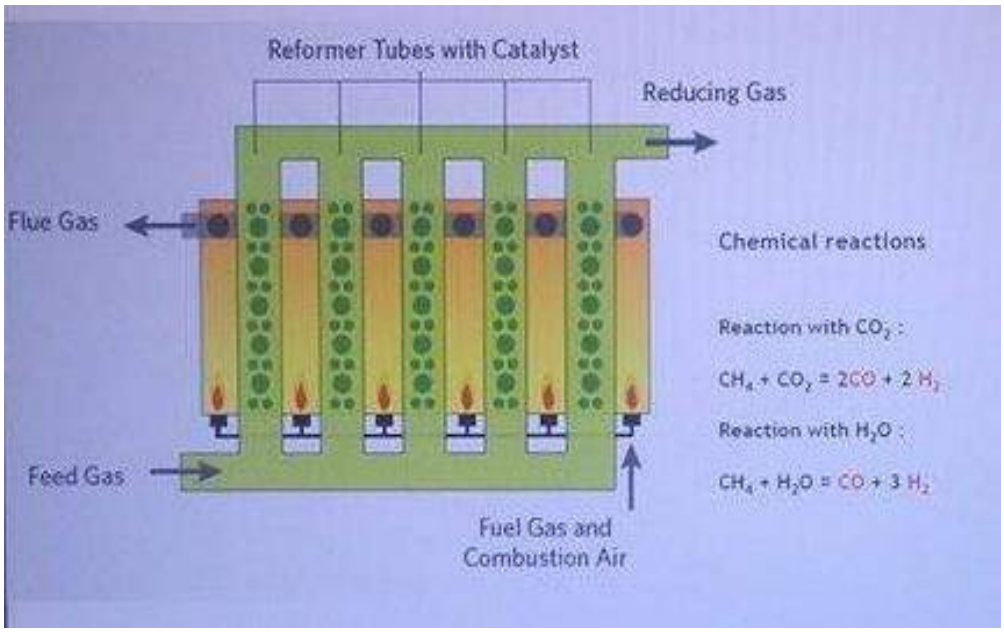
16. CHARGING OF THE FURNACE

Fig. 16. Charging of the furnace

17. GAS REFORMER

Fig. 17. Gas reformer

18. PRODUCTION OF REDUCING GAS FROM NATURAL GAS IN GAS REFORMER



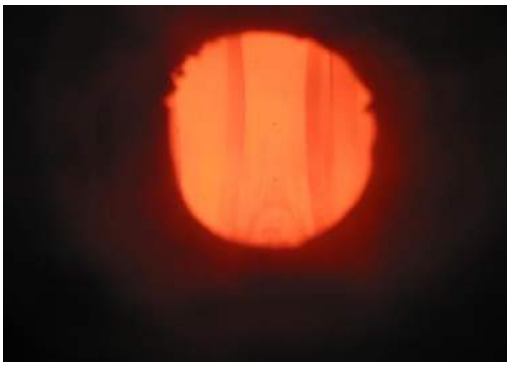


Fig. 18. Production of reducing gas from natural gas in gas reformer

19. HEAT AND ENERGY RECOVERY

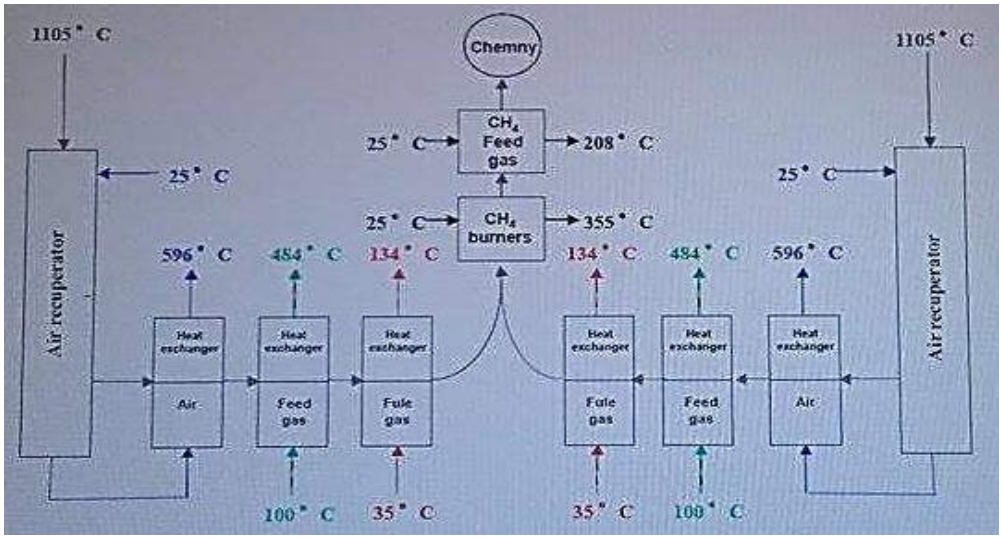


Fig. 19. Heat and energy recovery

20. CHEMICAL COMPOSITION OF DIFFERENT GAS CIRCUITS

Table 1. Chemical composition of different gas circuits

	Erdgas	Bustlegas	Kühlgas	Prozeßg.	Feedg.	Reformg.	Topgas	Brenng.	Sperrgas
H_2		56,56	21,62	43,99	44,87	57,94	44,95	43,45	
O_2									0,96
N_2	1,98	3,04	1,87	2,31	1,63	2,02	1,53	1,33	83,84
CH_4	91,35	3,22	65,81	2,69	15,49	1,28	2,65	3,08	
CO		34,33	7,47	31,98	19,66	36,27	30,69	30,91	
CO_2	0,89	2,85	0,96	19,03	17,20	2,49	20,18	21,23	15,20
C_2H_6	4,61		2,27		0,97				
C_3H_8	1,17				0,18				

21. ENVIRONMENT

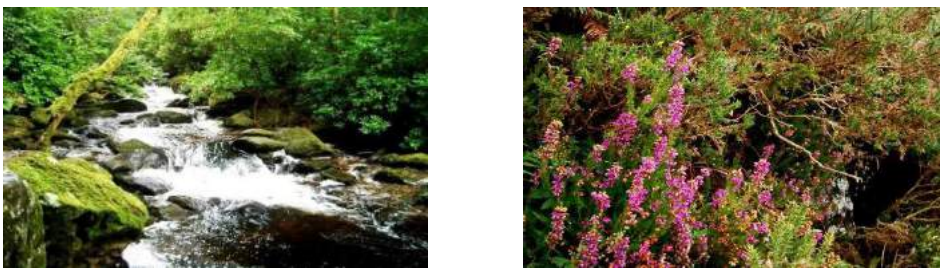


Fig. 20. Environment

- ArcelorMittal Hamburg: 824 kg CO2 / t wire rod (mean value 2015)
- 65% compared to the German steel industry (1360 kg CO2 / tsteel) in 2010.