

KIIT POLYTECHNIC, BHUBANESWAR

LESSON PLAN Session (2023-2024)

Discipline : Metallurgy	Semester: 4 th Sem/Summer-2024	Name of the Teaching Faculty: Deepak Kumar Patra, Asst. Professor Email ID: deepak_patrafmt@kp.kiit.ac.in
Subject: Sponge Iron and Ferro alloys (Th-4)	No. Of Days/Week - 4	Start Date: 16/01/2024 End Date:
Week	Class Day	Theory Topics
1st	1st	Introduction.
	2nd	Historical Development & reasons for Rapid growth of DR Process.
	3rd	Chronological Evolutions of some of the DRI Processes & conventional versus DRI Steel Making.
	4th	Direct Reduction of Iron Ore.
2nd	1st	Discussion on possible questionnaire
	2nd	Principles of Direct Reduction Reactions.
	3rd	Reaction between Coal, Oxygen and Carbon dioxide.
	4th	Reaction between Iron ore and CO (Set-II).
3rd	1st	Reaction Mechanism in Coal based DRI & reaction Mechanism in Gas based DRI.
	2nd	Reduction by Carbon monoxide, reduction by Hydrogen, Boudourd reaction and Reduction by Carbon.
	3rd	Carbon Deposition & kinetics in DRI.
	4th	Factors Influencing the Reducibility of Iron Ore.
4th	1st	Rate Controlling Theories.
	2nd	Quiz Test -1
	3rd	Coal based DR process using rotary kilns. SL/RN, CODIR, ACCAR.
	4th	TDR, OSIL, Krupp-Rein processes.
5th	1st	Coal based processes using reactors other than rotary kilns.
	2nd	Rotary hearth processes based on Inmetco, fastmet, It mk-3,
	3rd	Tunnel kiln processes kinglor-meter, hogans.
	4th	Gas based direct reduction.

6th	1st	HYL processes, MIDREX process.
	2nd	Fluidwise bed processes-FIOR-HIB.
	3rd	Uses of DRI in iron making and steel making.
	4th	Discussion on possible questionnaire
7th	1st	Raw materials of Sponge Iron Making.
	2nd	Chemical and Physical Tests on iron ore: Chemical composition, Reducibility, Strength, Tumbling, Abrasion and Shatter Index, Porosity, Bulk Density, Thermal Degradation Index (TDI).
	3rd	"Do"
	4th	Tests on Non Coking Coal: Proximate and Ultimate Analysis, Reactivity, Calorific Value, Coking Index, Swelling Index, Ash Fusion Temperature, Bulk Density.
8th	1st	"Do"
	2nd	Effect of Iron Ore size on Reduction.
	3rd	Carbon Enrichment of Sponge Iron.
	4th	How Carbon Enrichment of Sponge Iron is performed.
9th	1st	Flow of Solids in the Reactor or Kiln.
	2nd	Process Parameters of Sponge Iron Production: Raw materials, Iron Ore Feed Rate, Coal Feed Rate , Blow Coal Pressure.
	3rd	C/FeRatio, Dolomite Feed, Rate, Reduction Coal to Blow Coal Ratio , Ratio of coarse and Fines in Blow Coal.
	4th	Temperature Profile, Kiln Speed, Ore Retention Timeand Cooler Discharge end Pressure.
10th	1st	Nonmagnetic Percentage in the Kiln Discharge.
	2nd	Discussion on possible questionnaire
	3rd	Daily Operating Parameters.
	4th	Operational Abnormalities: Process Pressure Fluctuations, Temperature deviations, Back Spill, Loss of Process Fan(s), High Temperature of Cooler discharge, Loss of Product Quality.
11th	1st	Major Problems of DRI Kiln Operation: Injection CoalJam, feed Pipe Jam, transfer Chute Jam, main Drive Problem, refractory failure their causes and remedies
	2nd	Shutdown Procedure: Normal Shutdown Schedule for a 500 TDP Kiln.
	3rd	The Start Up process: Heating of the Reactor Refractory.
	4th	Accretion Formation.
12th	1st	Key notes on process plant operation.
	2nd	Discussion on possible questionnaire

	3rd	Sampling: Sponge Iron and the Raw materials.
	4th	Chemical Analysis of Sponge Iron, Iron Ore, Lime Stone/Dolomite and Coal.
13th	1st	Scheme of Quality Control of input Raw Materials: Reactor Feed Iron Ore, Reactor feed Coal, Back –SpillCoal, Slinger Coal.
	2nd	Determination of Total Iron (FeT), Ferrous Iron and metallic Fe.
	3rd	Quiz Test -2
	4th	Air Pollution Mitigation Measures, fugitive Dust Generation, water Pollution Mitigation Measures.
14 th	1st	Solid Waste Generation and Disposal, hazardous Wastes and Chemicals, occupational Health and Safety.
	2nd	Environmental Monitoring & Environmental Standards.
	3rd	Discussion on possible questionnaire
	4th	Introduction to Ferro-alloying elements, Different Ferro alloys.
15th	1st	General methods of producing Ferro alloys: carbothermic and aluminothermy Reductions.
	2nd	Refining of Ferro alloys.
	3rd	Production of individual Ferro alloys: Ferro manganese, Ferro chrome, charge chrome, ferrosilicon Fe-Ti, Fe-W, Fe-Mo and Fe-V.
	4th	Discussion on possible questionnaire

Recommended Books: Fundamentals of Sponge Iron

Making by C.Mohapatra & D. Patnaik

Reference Books: Alternate methods of iron making by Surya Kumar Dutta & R.Saha