DRI UPDATE

December, 2018

EDITORIAL

Dear Readers,

I am sure you might have gone through our earlier E-Magazine of September, 2018 issue. I hope you might have found that interesting and informative.

We are bringing out this issue focusing on coal based DRI activities. It mainly contains the details of Technical Workshop on Energy Efficiency Technologies organized in association with Bureau of Energy Efficiency, Ministry of Power, Karnataka Renewable Development Ltd, a Government of Karnataka Undertaking and KSIMA on 28.11.2018 at Ballari, Karnataka.

The magazine contains two papers highlighting the innovative ideas which may have major impact on the financial performance of coal based DRI producers. The third paper is on the safety procedures and practices required to be followed during the steel making through the induction furnace route.

I take this opportunity to wish our Readers a very Happy, Prosperous & Growth Oriented 2019!

Deependra Kashiva
Executive Director

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Report on "Technical Workshop on Energy Efficiency Technologies"

Sponge Iron Manufacturers Association (SIMA) in association with BEE, Ministry of Power, Karnataka Renewable Energy Development Limited (KREDL), a Karnataka Government Undertaking organized a **Technical Workshop on Energy Efficiency Technologies** on 28.11.2018 at Ballari, Karnataka.

The Inaugural Session was addressed by Mr. A B Basavaraju, MD, KREDL, Mr. A K Asthana, Sr. Project Coordinator, GIZ Germany, Mr. Deependra Kashiva, Executive Director, SIMA and senior office bearers from Karnataka Sponge Iron Manufacturers Association and South India Sponge Iron Manufacturers Association.

In his key note address, Mr. Deependra Kashiva, ED, SIMA gave the background of conceiving this workshop in the Ballari region. He highlighted the important role being played by Indian sponge iron industry in the steel production. He also informed the participants about the importance given to the sponge iron industry in the National Steel Policy 2017 which envisages the need to produce 80 million tonnes of sponge iron from the current level of about 25 million tonnes to achieve the targeted crude steel production of 255 million tonnes by 2030-31.

Senior representative of BEE along with sector expert presented a paper on **"PAT Achievements and Way Forward"**. It was followed by Mr. Asthana's presentation on **"Coal Blending for Enhancing Combustion Efficiency"**. Other important papers presented by Representatives of EL Measure, Elpro Energy Pvt Ltd, Thermax Ltd and Tata Sponge Iron Ltd.

Major "Takeaways" from this Workshop may be flagged as under:

1. During the discussions, it was found that few sponge iron (SI) producers have installed WHRB power plant which is contrary to the sponge iron producers in Chhattisgarh and Odisha where large number SI producers have installed the same. This was perhaps due to the fact that they do not have subsequent steel making facilities and uncertainty about the PPA. On the several requests, the representative of Thermax visited 4 SI units and made suggestions to set up smaller WHRB power plant to meet their present power requirement on a much smaller capex.

2. ED, SIMA requested the participants to volunteer to spare their rotary kiln for carrying out the R&D for exploring the use of Syn Gas in the rotary kiln. Mr. T Srinivasa Rao, MD, Balajiswamy Premium Steels Pvt Ltd offered his 50TPD kiln for this purpose.

3. Presentation from Tata Sponge Iron Ltd was very much liked and lot of the people showed the interest in the action points outlined by their speaker which inter alia speak the use of catalyst (Thermact) in the coal which substantially reduces the cost of production of sponge iron.

Some of the photographs of the event are as under:

ED, SIMA delivering the keynote address


View of Participants

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TATA SPONGE IRON LIMITED

Energy Efficient Operations @Tata Sponge

Bijay Kumar Agrawal
Head-Electrical, CEA

28th November 2018

TATA SPONGE

The phases so far… and ahead

1983-85
First plant commissioning & trials
- First plant of 90,000 tpa capacity

1986-91
Evolution and stabilizing operations
- Overcoming teething troubles
- Rehabilitation plans to stabilize operations (capacity increased to 120,000 tpa)

1992-97
Consolidation of operations and market
- Improve plant availability
- Recovery from all losses
- First net profit and paid dividend
- Own Railway siding #1

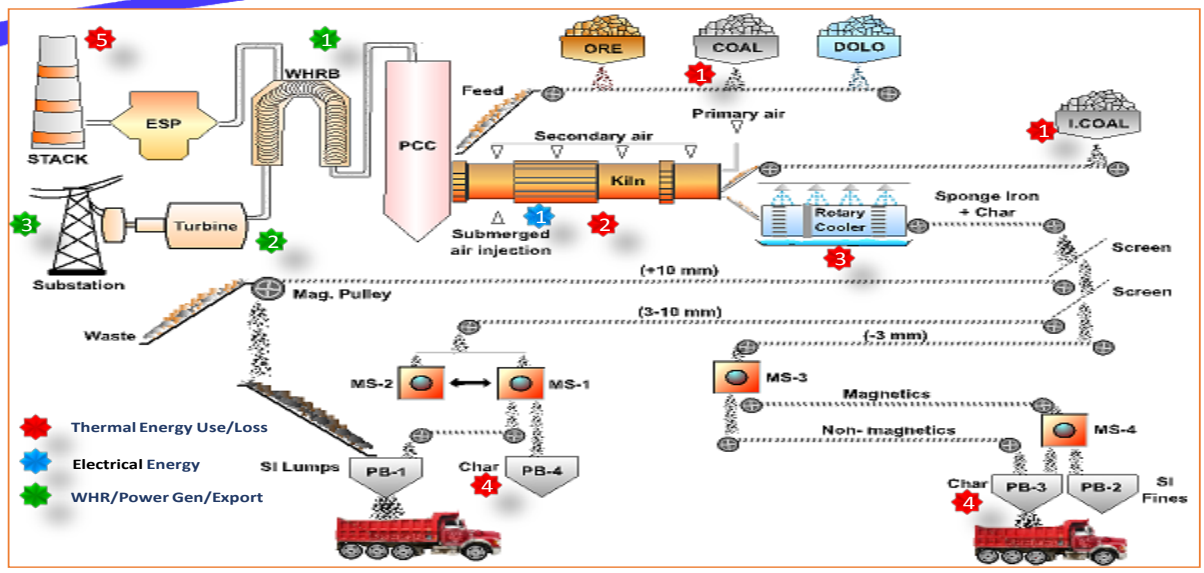
1998-2007
Growth and diversification into Power
- 2nd kiln – capacity to 240,000 tpa
- 2 Power Plants of 26 MW capacity
- 3rd kiln -capacity to 390,000 tpa

2008-17
Towards Industry Leadership
- Improve equipment efficiencies (TPM)
- Benchmarking performances
- 2nd Railway siding

2018-23
Growth Plan
- Steelmaking
- Captive raw material sourcing

TATA SPONGE

Manufacturing Process with Energy mapping



TATA SPONGE

Approach toward Energy Management

WITH WHAT (Philosophies & Tools)

- Rotary Kiln equipment
- Power plant equipment.
- 220KV System equipment
- Right Mix of Coal Procurement
- TPM Methodology/ Statistical Tools

WITH WHOM (Competence/Support)

- Support from Promoter
- 3 level structure
- Competent & skilled Workforce
- Professional Consultants

INPUTS

- BEE/PAT Targets in ToE
- Energy Policy
- Energy Audit recommendations
- Best Practices & Benchmarks

OUTPUTS

- Compliance to PAT target
- Reduction in tCO2 emission per ton of DRI

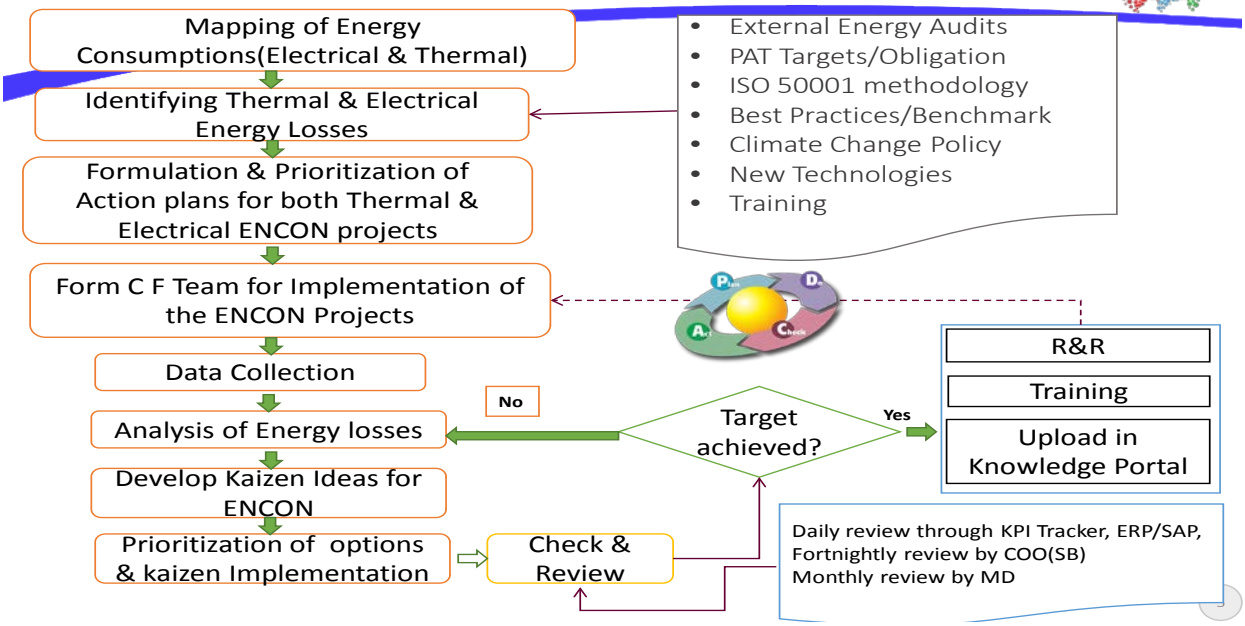
HOW (Procedures & Methods)

- Energy Awareness Campaign
- Energy Efficiency Improvement Activities
- Implementation of energy audit recommendations
- IT Based Systems (KPI tracking, ERP)
- Automations to check energy wastage

WHAT RESULTS

Efficiency	Effective
Reduction in C/Fe Ratio	Increase in Power Export to Grid
Reduction in Coal per ton of DRI	Reduction in SEC(Elec)
Sp. Steam Consumption	Reduction in SEC (Thermal)

Approach to Energy Efficiency Improvement Activities



List of some of the implemented Encon Projects:

1. **Implementation of Dynamic Operation model through use of Artificial Neural Network(ANN) for accretion control , improving quality of product and improving Kiln availability.**
   - Identified Basic parameters and their inter relationship to control quality and accretion.
   - Temperature control is of paramount important for accretion control
     - Parameters for prediction of temp at different zones are FC in feed Coal, Kiln pressure and MLD position(Regression analysis)
   - Parameters identified to control quality are FC in injection coal, Kiln RPM, air blown through PAB and SAB

Benefit:

- Reduced fluctuation of Kiln inlet and outlet pressure.
- Auto operation of MLD of ID fan
- Gain in Operating Days of Kiln:14days.
- Surpassed the rated production capacity & produced 417000MT against the rated capacity of 390000MT of SI

2. Adding Value to Waste-Injection of char with prime coal

- Mixing fresh char with injection coal (As imported coal char contains around 40% FC)
- Char added up-to 4% (of total injection coal) in yard in a mechanized way to reduce moisture content in injection coal from 10.8% to 8.3%.
- Prevented frequent jamming of injection system during rainy season.

TATA SPONGE

3. Briquetting of coal fines to reduce coal consumption

Parameter	Unit	Before 15 days	After 7 days	Remarks
Non-Magnetic	%	14.6	14.8	No Change
F.C. in Non-Magnetic	%	40.3	37.8	Decreased
C/Fe	Ratio	0.435	0.430	As per design of experiment
Back Flow	Mt/day	1.00	1.00	No Change
Fe(M) of lump Product	%	81.6	83.9	Improved
Fe(M) of Fine Product	%	82.0	81.8	No Change
Sulphur in Lump Product	%	0.027	0.027	No Impact
Sulphur in Fine Product	%	0.029	0.030	No Impact
F.C.in ESP dust	%	18.3	19.5	Increased
Shell Temperature	Eye estimation	No change	No Change	
Fines (-3mm)in Feed Coal	%	33.0	32.5	Decreased due to fines in Briquette
Steam Generation	Mt/hr	35.0	36.0	No changes
ESP Silo discharge	No of trips	4.52	4.68	increased
Kiln feed rate	Mt/hr	27.0	27.0	Same
Production	Mt/day	422	422	same
Use of SA Coal	%	100	100	No Change

- Trial was conducted for 7 days.
- 1.6 Mt/hr coal briquette replaced 1.75Mt/hr Coal from feed end.
- FeM percentage in product increased by 0.5%.
- All these data shows briquette has favorable impact to reduce coal.
- Reduce 154 kg of coal/hr/Kiln.
- Potential cost saving: Rs 400/mt of DRI and Rs 273 lakh/year.

TATA SPONGE

MIXING

PRESS

DRYING

BRIQUETTES

Briquette strength : Achieved (T.I > 75%)

TATA SPONGE

4. **Use of Catalyst with coal to reduce Specific Coal consumption**
   - The catalyst-Thermact has been developed in IIT, Mumbai
   - Directly charged alone with coal charged inside the kiln
   - Improves char reactivity of coal and optimise coal combustion.

5. **Waste Heat recovery from Coal Based DRI Rotary Kilns**
   - Inhouse generation of 26MW of Power
   - Inhouse consumption of 7MW is supplied through own power.
   - Surplus power is sold which contributes to 6 % of revenue of the company.

TATA SPONGE

6. Kiln Outer Shell Painting ….Improving Energy Efficiency

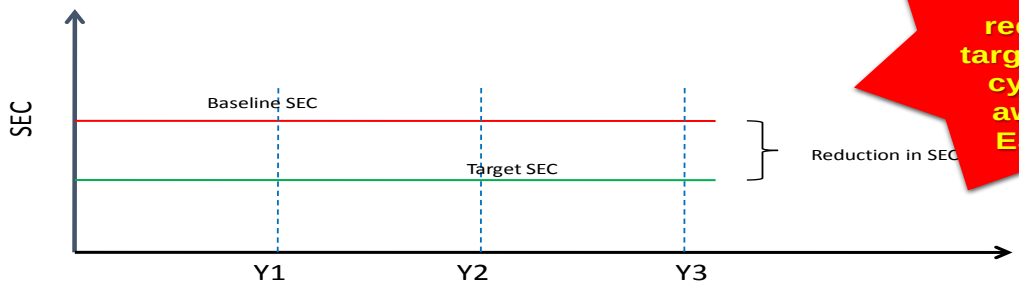
Painting of Heat resistance paint (Alumina based)- Tempshield on Kiln-3 shell 50 meters out of 80 meters.
Change of shell temperature :Uncoated shell -385°C and Coated shell - 370°C

7. Supplementing the steam through auxiliary combustion of waste DE dust at PCC.
8. VFD control of various pumps & fans which were running in throttled conditions: Cold well Pump(90KW), Hot well Pump(90KW), SAB (120KW) , PAB,
9. Replaced the impeller of ESP ID fan of Kiln-2 with energy Efficient impeller. Energy consumption reduced by 2000units /day.
10. Auto control of operation of cooling tower fan with sponge temperature.
11. Replacement of conventional light fittings with LED light fittings at both inside plant and township.
12. Improved maintenance practices.

TATA SPONGE

13. Installed 235KW Roof Top Solar Panel

Performance at the end of PAT-cycle-1



Over achieved the SEC reduction target in PAT cycle-1 & awarded ESCerts

- Baseline SEC : 0.581 ToE /MT of SI
- Target SEC : 0.551ToE /MT of SI
- Baseline production : 344557MT
- PAT cycle :2012-2015

Technological Challenges:

1) Technological options for creating Oxygen Enrichment inside the DRI rotary kiln to improve utilization of Thermal Energy.
2) Technological options for recovery of heat which is being lost
   a)from exhaust gas (which is at 170-180°C)
   b)Indirect cooling of product from 1050°C to 100°C

TATA SPONGE

Future plan

- Auto regulation of Roots blower to control the quality of Sponge Iron.
- Auto control of SAB blowers to restrict accretion formation.
- Integration of dynamic model with multi gas analyzer to improve the quality of SI.
- Use of MATLAB for better prediction of process parameters.
- Working further with supplier to improve life of the paint to reduce the radiation loss
- Coal drying facilities to reduce specific coal consumptions

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SURAJ PRODUCTS LIMITED

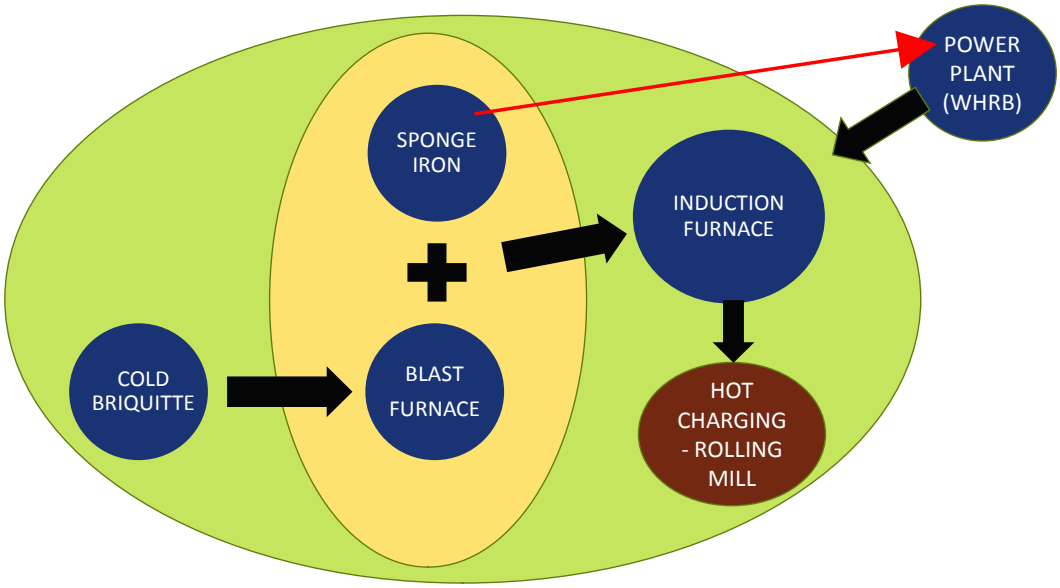
A 5 star rated company by SPCB, Odisha

https://ospcb.info/#

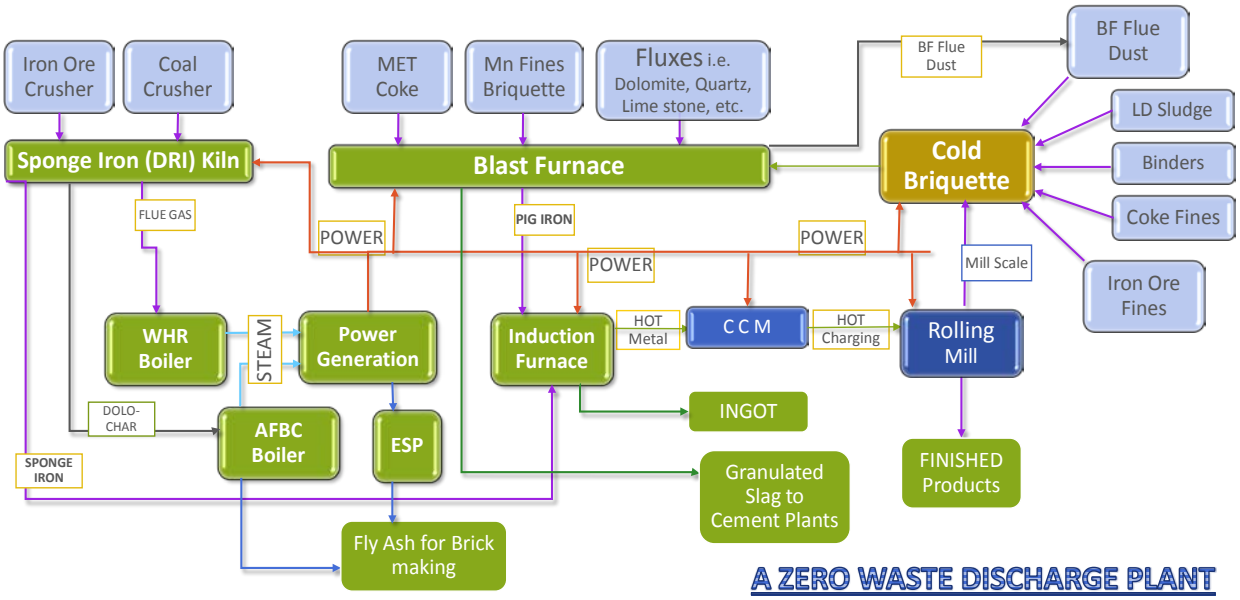
ABOUT US- A MICRO INTEGRATED STEEL PLANT

- 2002-2004: 3 x 50 TPD Sponge Iron (DRI) Kilns
- 2007-2010: 2 x 23 m^3 Micro Blast Furnace
- 2010-2011: Cold Briquetting Unit
- 2017-2018: 6 MW Power Plant based on WHRB & AFBC
- 2017-2018: 3 nos. Induction Furnace
- 2019-2020: Continuous Caster-Hot charging-Rolling Mill

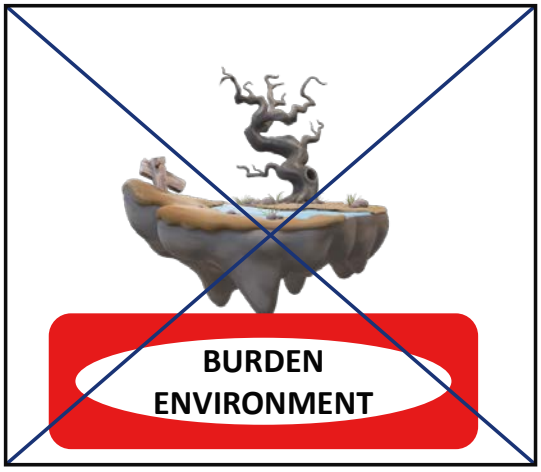
INTEGRATION



MICRO INTEGRATED STEEL PLANT



WE BELIEVE

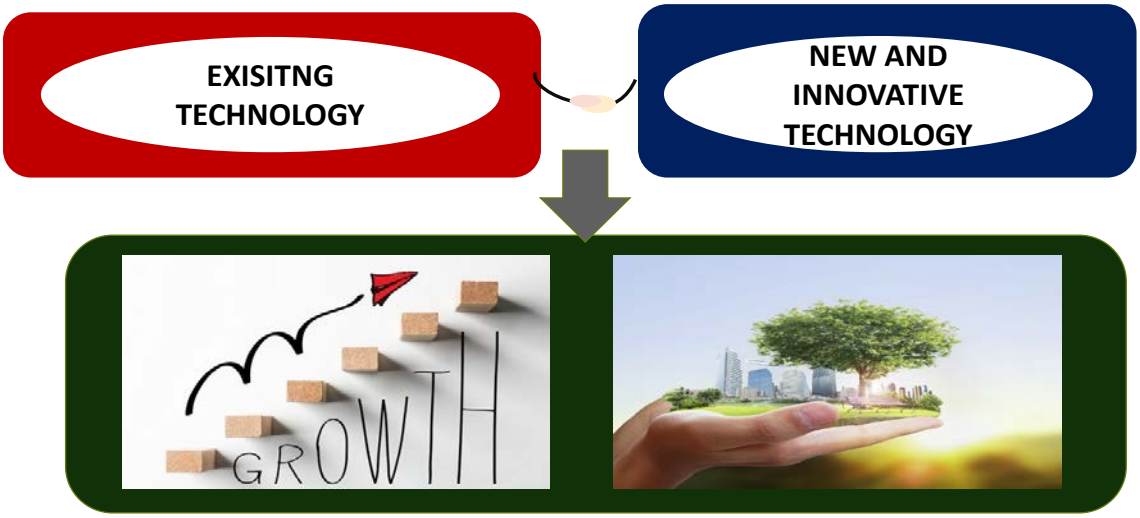


INNOVATION

We found **solutions** without **pollution**

http://briquettingindia.blogspot.in/2015/11/create-pollution-free-environment-by.html

SMART ADOPTION



http://www.hbng.com/7-key-steps-to-developing-a-business-growth-strategy/
https://www.businessdayonline.com/exclusives/analysis-sub/article/sustainability-isnt-expensive-profitable/

FORCED DRAFT COOLING

Unnecessary water consumption by industries = Burden to the planet

COUNTER-ATTACKING THE ISSUE

*We conceived, developed and installed **Forced Draft (FD) Air Cooler** replacing Gas Conditioning Tower (GCT) to cool flue gases in sponge iron industry **saving millions of litres of water annually.***

SINGLE WHRB USING THREE 50 TPD DRI KILN

Individual 50 TPD sponge iron kiln = Insufficient flue gas

SOLUTION

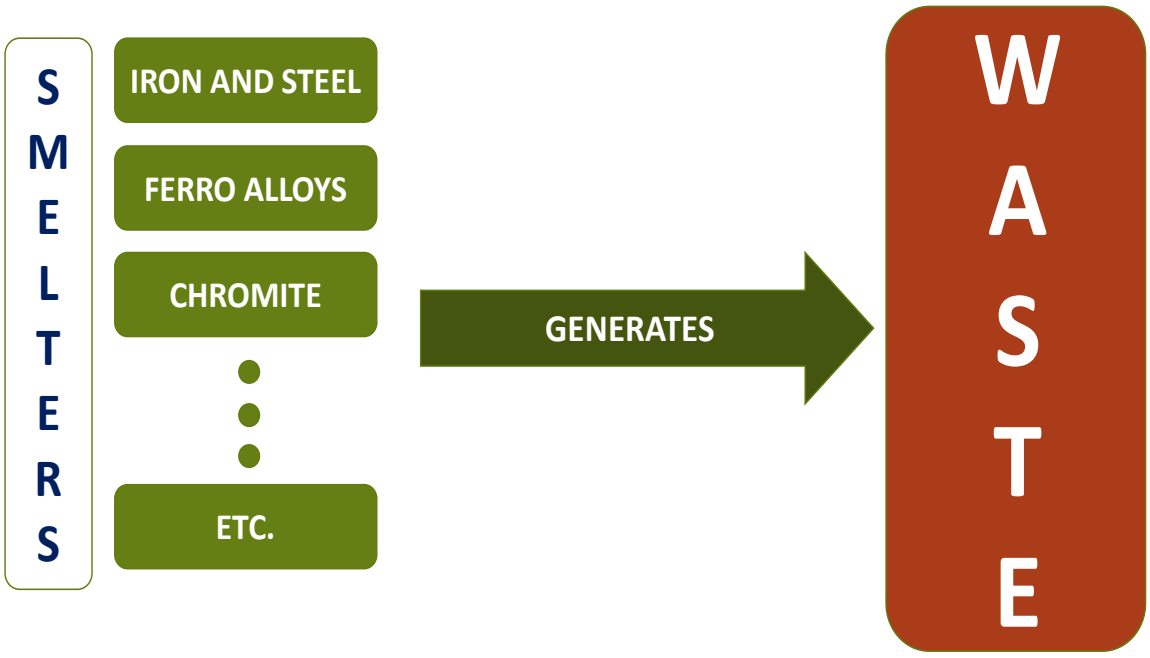
An in-house designed novel refractory damper and vessel to use flue gases from multiple 50 TPD of Direct Reduced Iron kiln in A **Single Waste Heat Recovery Boiler** (WHRB).

Moreover, we successfully **test fired Blast Furnace gas** in the same WHR Boiler for enhancement of power generation.

WE BELIEVE

Waste is indeed not the ultimate waste

PROBLEM



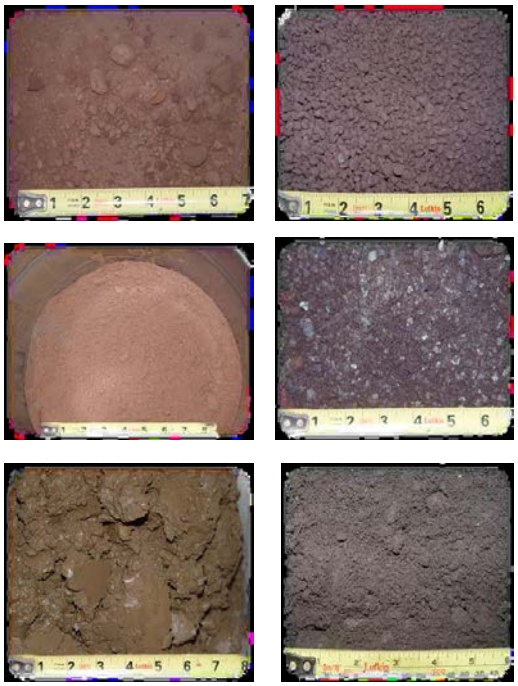
COLD BRIQUETTING FROM INDUSTRIAL WASTE

THE CHALLENGE OF PROCESS FINES

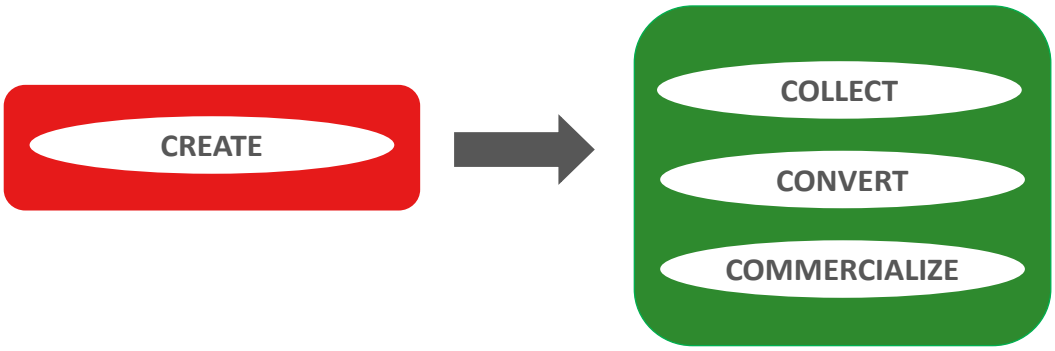
Extract value and avoid disposal issues

THE CHALLENGE OF PROCESS FINES

- Baghouse dusts
- Wet or dry sludge
- Chips andfines
- Mill scale



SOLUTION

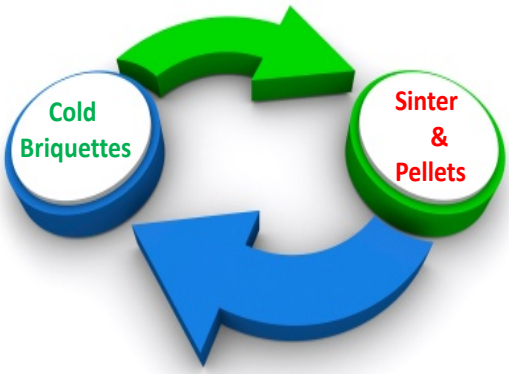


Waste created by existing Iron and Steel / Ferro Alloys Smelters

To be utilized by the "CREATERS"

SOLUTION

COLD BRIQUETTE FROM INDUSTRIAL WASTE



Cold Briquettes are substitute of Sinter & Pellets

STIFF EXTRUSION – IDEAL FOR AGGLOMERATION

Agglomerates dust, sludge and various particle sizes and densities

Vacuum improves briquette strength and binder effect

Change size/shape of product in minutes



OUR TECHNOLOGY

INNOVATIVE TECHNOLOGY BY:

SURAJ PRODUCTS LIMITED

+

STEELE Since 1889

J. C. STEELE & SONS

STIFF EXTRUSION BY J C STEELE & SONS

Developed for brick and structural clay products

Process forms bulk raw materials into durable units

Strong enough for rough handling in "green" state

STEELE STIFF EXTRUSION

STEELE - THE BEST OF STIFF EXTRUSION

- High pressure/vacuum for exceptional green strength
- Proven technology with simple, reliable equipment
- Continuous operation

COLD BRIQUETTING FROM INDUSTRIAL WASTE

RELAX

NO HEATING

NO RESIDUE

NO WASTE WATER

https://www.accupstate.com/
https://www.1001freedownloads.com/free-clipart/water-pollution-3
http://www.italiangoodnews.com/zero-waste-italian-town-pioneer-waste-recycling/
https://zerowasteindavis.org/2015/04/27/zero-waste-will-soon-be-25-easier-in-davis/

COLD BRIQUETTING FROM INDUSTRIAL WASTE IN IRON AND STEEL INDUSTRY

- **Blast Furnace Flue Dust**
- **L D Sludge**
- **Coke Fines**
- **Manganese Ore Fines**
- **Binders**

100% Replacement of Iron Ore with Briquettes made of Steel Plant waste in blast furnace OF SURAJ PRODUCTS LIMITED.

CHEMISTRY OF RAW MATERIALS FOR BRIQUETTING IN IRON AND STEEL INDUSTRY

FLUE DUST →

Chemical Analysis

Fe	:	31-38%
Al_2O_3	:	12-13%
CaO	:	7%
MgO	:	1%
SiO_2	:	10-11%
PbO	:	2-5%
Un-burnt Carbon	:	14-30%

LD SLUDGE ←

Chemical Analysis

Fe	:	40-50%
CaO	:	16-20%
MgO	:	2-4%
SiO_2	:	3-4%
Al_2O_3	:	1%

COLD BRIQUETTING FROM INDUSTRIAL WASTE IN FERRO ALLOY INDUSTRY

- Ferro alloy fines and concentrates (Ni, Mn, Cr)
- Metallized fines
- Sludge, dust and fines
- Iron ores and concentrates
- Mill scale
- Coke breeze
- Any combination of the above

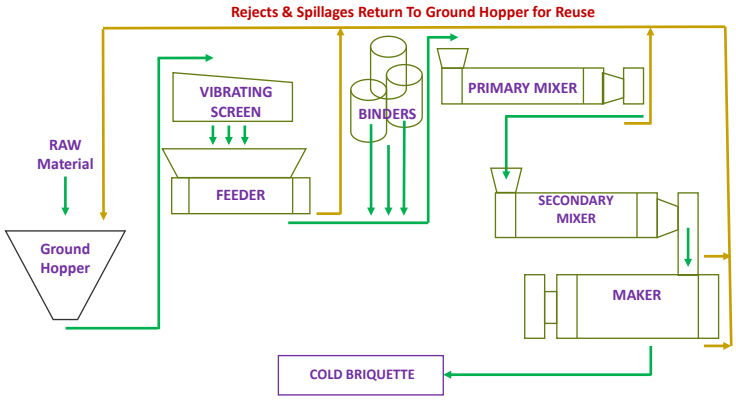
COLD BRIQUETTE

Producing
GREEN Pig Iron
using cold briquette
made from industrial waste

PROCESS OF COLD BRIQUETTE MAKING

RAW MATERIALS
SCREENING
BINDERS
MIXING AND MAKING
COLD BRIQUETTE

PROCESS OF COLD BRIQUETTE MAKING



FLOWCHART OF COLD BRIQUETTE MAKING

GREEN BRIQUETTE JUST AFTER EXTRUSION

COLD BRIQUETTE

Our BRIQUETTES offer superior durability and reducibility

Shippable	300 km between production and smelter - shipped by Suraj Products Limited
Rugged	20+ transfers
Weather-resistant	Long exposure to weather with no negative effect
Chargeable	Up to 50% charge rate / submerged EAF

AUGER EXTRUSION

Typical case study – development of an engineered pellet

Mechanical, metallurgical, and chemical evaluation of the pellet

Chemical analysis

Sample	TOTAL Fe	Fe++	Satmagan Fe	C	S	SiO2	Al2O3	MnO
Raw Material Mix	39.88%	12.19%	8.90%	27.39 %	0.19%	6.03%	2.03%	0.20%
Extruded Pellet	38.49%	10.15%	8.54%	24.42 %	0.24%	7.46%	2.31%	0.19%

Sample	CaO	MgO	TiO2	P	Na2O	K2O	ZnO	LOI
Raw Material Mix	**2.38%**	**0.62%**	**0.18%**	**0.14%**	**0.11%**	**0.14%**	**0.12%**	**28.18%**
Extruded Pellet	**5.85%**	**0.75%**	**0.18%**	**0.11%**	**0.20%**	**0.15%**	**0.14%**	**26.59%**

ISO 3271 Tumble Test | TI= 86.0 | AI= 12.0

TOWARDS SUSTAINABILITY

Characterization of various agglomeration technologies according to the criteria of the best available technologies (BAT)

	BAT criterion	Agglomerated iron-containing material		
		Sinter	Pellet	BREX*
1	The minimum level of impact on the environment, kg / t:			
	- dust	≤1.200	≤0.600	0.05
	- nitrogen oxide	≤0.550	≤0.535	0
	- sulphur dioxide	≤4.000	≤0.500	0
	- carbon oxide	≤14.000	~0	0
	Total emissions, kg / t:	≤20.000	≤2.000	≤0.050
2	Resources consumption:			
	- solid fuel, kg/t	23.6-48.9	0	0
	- gaseous fuel, m^3/t	2.45-6.3	9.5-15.0	0
	- Electricity, kWh / t	23.0-48.7	29.0-48.5	10.0-15.0
3	Investments, USD/t per day	~5000	~5500	~2000
4	Implementation period, years	3	2	1

* STRIFF EXTRUDED BRIQUETTES

Above Table is represented by Dr. A. Bizhanov

AUGER EXTRUSION

Typical case study – development of an engineered pellet

ISO 13930 Dynamic Low Temperature Disintegration

+6.3 mm (1/4")	6.3 x 3.15 mm (6 M)	3.5 x 0.5 mm (32 M)	-0.5 mm (-32 M)	Before Test Weight, g	After Test Weight, g
97.00%	0.10%	0.20%	2.70%	500.5	456.2

"The results of the ISO 13930 testing were impressive, achieving 97% in the +1/4" size fraction.

…above-average porosity (relative to a 'normal' iron oxide pellet) due to the high amount of carbon loss during reduction

The samples should be thought of as a hybrid feedstock – part iron ore, part carbon and part flux…"

--Jack Swanson
University of Minnesota Duluth

Natural Resources Research Institute
University of Minnesota Duluth
Driven to Discover

USHER

Suraj Products Limited, India ushers GROWTH and INNOVATION since 2011

Briquetting by JCSTEELE's Stiff Extruder for metallurgical use pioneered by us is being followed by…

- Large Steel Plant, Japan (NDA) (Blast Furnace, since 2012)
- Assmang Cato Ridge, South Africa (Ferro Alloys, 2016)
- JSC Chelyabinsk Electrometallurgical Integrated Plant, Russia (Ferro Alloys, 2017)
- TNC Kazchrome, Kazakhstan (Ferro Alloys, 2017)
- Large Steel Plant, India (NDA) Blast Furnace, 2018
- many more…

http://blog.vynd.com/2017/12/26/soyez-un-leader-devenez-un-vov-voice-of-vynd/

FINALLY

We have begun our journey towards "SUSTAINABLE" iron and steel production

https://www.osler.com/en/expertise/services/emerging-and-high-growth-companies

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Induction Melting Furnaces Safety procedures and practices

S. P. Chhabra, Steel Consultant

Medium Frequency Induction Furnaces have the potential to produce metals in industrial settings safer than ever. However, proper precautions must be taken to avoid injuries, damage or loss of product.

Safety precautions regarding melting technology are various and extensive. Here is a basic guideline to suggest safety procedures and practices when using an induction melting furnace.

A. General for all employees

1. **Ensure All Employees are Properly Trained:**

Training is a key step in preventing work place accidents. It is the employer's responsibility to make sure that only qualified workers handle melting furnaces, and that trainings are up-to-date and thorough. Induction furnace manufacturers often produce their own safety guides and user manuals for various melting furnace equipment. Make sure that your workers have total access to all necessary documents for reference.

2. **Ensure All Workers Have Proper Gear**

Even if your workers are properly trained and experienced with induction melting, accidents still happen. Luckily, there are ways to minimize damage in the case of an emergency or malfunction, such as a molten metal splash. One of the biggest ways to reduce the likelihood of an injury is to require employees to wear proper safety gear at all times and to strictly enforce protective equipment regulations. Personal protective gear that can save lives includes, but is not limited to:

- Safety hoods
- face shields
- Flame resistant aluminized coats, leggings, and gloves
- Lace less Safety Boots

- Secondary protective clothing, like natural-fiber coveralls and flame retardant washable undergarments

3. **Use Reminders to Prevent Common Safety Mistakes**

Finally, though there are many potential safety hazards involved with using induction melting furnaces, some problems are more common and more dangerous than others. As an extra precaution, consider posting additional warning signs and safety reminders in a clear, easy-to-see location lest workers forget the basics. Be sure to regularly remind workers of dangerously common issues, such as bridging, cold charges, and molten metal splash. Hanging reminders, like the one below, might just save a life Use brief, easy-to-read guides like this one for quick danger reminders:

Common Causes of Molten Metal Splash:

- **Wet or moist charge material**
- **Dropping heavy metals into molten baths.**
- **Moisture or wetness on tools and additives**
- **Centrifugally cast or sealed scrap and scrap rolls**

4. **Emergency escape routes**

There must always be two independent emergency escape routes from the furnace platform to meet any emergency. These routes must be kept cleared at all times and may not be blocked even for short time.

B. For Production employees

1. The refractory that is used to line the furnace must be suitable for the material being melted.

Refer to the refractory manufacture's specifications. Be sure that furnace lining has been thoroughly dried and sintered in accordance with the Manufacture's recommendations.

2. Regularly inspect furnace lining to minimize the possibility of a dangerous "run through "occurring.

3. Power must not be turned on in any one of the following conditions;

- There has been an earth leakage trip, indicating metal penetration to the coil.
- The solid-state power supply start running at low voltage and reduced power these conditions indicate an eroded lining. (this condition also Indicated by low power factor)
- There is excessive surface slag visible. This is evidence of serious lining damage.
- The water temperature in the coil is higher than normal (more than 60°C to 65°C)

Each of these conditions indicates that molten metal may be next to the coil and require immediate evacuation of the area until all of the metal in the furnace has solidified.

4. For manganese addition small box bucket to be used as there is possibility of accident due to splashes.

5. Ensure all charge materials i.e. scrap / sponge iron / ferroalloys are dry. Wet materials are serious safety hazard. Moisture instantly turns into steam when coming in contact with molten metal, expanding to 1600 times its original volume and producing a violent explosion.

6. Workers doing their work near the heated area to be provided rest in between to take care of heat stress.

7. Avoid overloading the furnace and its components.

8. Furnace platform to be always kept as clean as physically possible

C. For Maintenance employees

1. Keep all cabinet doors locked and make keys available only to those who require access to the enclosure.

2. Always use independent methods to support a tilted furnace whenever working on or near.

3. Never work or enter the high risk zone like running crucible/ “ON” condition of solid state generator. Always work on electrical section of furnace with main breaker off and keep fuses with yourself while working.

4. Preventive maintenance schedule's (say bimonthly/monthly) to be strictly followed. During this period specific attention should be given to the following:

    - Ensure all interlock's, limit switches, indicating lights, earth leakage alarm and trip are functioning.
    - Water flow in each circuit is sufficient.
    - All terminal connections are tight.
    - Hydraulic oil leakage, if any, is satisfactorily attended.
    - Bulging MF capacitor, if any, is given due attention. A crack in a capacitors weld may permit oil leakage, causing the unit to arc internally and generate gas resulting in violent explosion.
    - The furnace coil cradle assembly inspected, cleaned of dust, small particles of scrap and other impurities using a vacuum cleaner.
    - The furnace crucibles underground room area is thoroughly clean.
    - Any problems faced subsequent to earlier preventive maintenance are duly attended.
    - Recurring nature of any problem to be thoroughly investigated and attended to full satisfaction.

5. For attending MF capacitors or any other capacitors, wait for few minutes after switching off the supply (breaker / switch). This allows capacitors to discharge.

6. At a given regular interval (say half yearly/yearly) transformer and motors IR value, transformer oil dielectric strength, silica gel colour, operation of relays and there setting and proper double earthling of all electrical equipment to be checked and earth resistance is within limit ensured. Any abnormal sound or malfunctioning should be investigated and duly attended.

Maintain proper record of all activities.

D. General

1. The furnace layout should consider safety of personnel and equipment as of prime importance.

    Between the furnace crucibles and electrical equipments (Static frequency converter and MF capacitors) solid wall is a prime need to avoid any damage to costly equipment and for human safety in case of metal leakage.

    Prefer to have wall between two crucibles. If workers are working on standby crucible and any accident happens in running furnace than middle wall will save workers.

2. The furnace should have features like automatic charging systems, computer control and compressing of the charged scrap by hydraulic pusher. These systems enable people working with the furnace to stay further away and do their job more efficiently as well as reduce the manpower requirement.

3. Provide a system to diligently examine all input materials.

4. At a given regular interval (say once a month) to have safety meeting wherein top management takes a key part. Besides discussing, the team should go around the furnace and critically observe environment, hot spots, abnormalities' and scope of improvements in operation and maintenance.

5. Once in a year the organization should conduct safety audit and have accreditation of OHSAAS: The relevant standard being; IS 18001:2007 Occupational hazard and safety requirement system.

Lastly, it is essential to ensure that statutory requirement such as pollution control, ventilation system, installation of safety equipment i.e. for fire prevention and fire fighting, first aid boxes at critical positions, glasses for eye protection and availability of good quality drinking water etc. are taken care of.

Safety Must Be Key Corporate Value

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