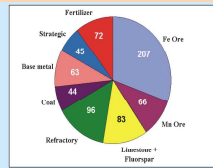


Technologies

Mineral Processing

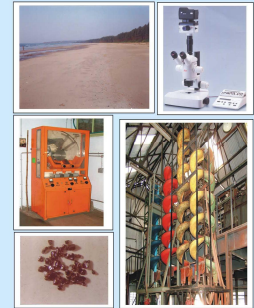


Metallic Minerals		
	Feed Grade	Conc. Grade
• Iron ore	40-60%	> 65% Fe
• Mn Ore	25%	46-48 % Mn
• Cr. Ore	20-30%	> 50% Cr ₂ O ₃
• Pb-Zn Ore	1.6% & 9.8%	58% Zn & 59.2% Pb
• Fe ore super conc.	1-4%	<0.3 % (SiO ₂ / Al ₂ O ₃)



Industrial Minerals		
	Feed	Conc.
• Barite	51%	97% BaSO ₄
• Fluorspar	28%	96% CaF ₂
• Graphite	14 %	98% FC
• Bauxite	53%	77% Al ₂ O ₃
• Limestone	43%	50% CaO
• <1%SiO ₂		
• Magnesite	10%	<2% SiO ₂

Flotation



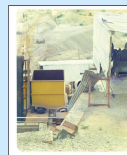
Beach Sand Processing

♦ Recovery of ilmenite (>57% TiO₂) from Indian coast

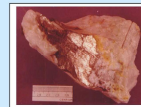
♦ Recovery of heavy minerals from low/medium grade Indian beach sand

♦ Value addition of low grade, fine grained Korean sand

Recovery of Values from Lean Tungsten Ore



- Wolframite enrichment from 0.2% to >65% WO₃
- Very fine dissemination
- Minerals of very low tenor
- Gravity & Magnetic separation based technology



Values from Secondary Resources

- ♦ Processing of waste dump to produce barite product
- ♦ Processing of BaCO₃ plant sludge to recover barite



- ♦ Recovery of Sulphur from sludge of H₂SO₄ plant
- ♦ Enrichment of phosphatic soil for acid grade concentrate



- ♦ Metal values from electronic waste
- ♦ Ferrite from Iron ore Fines



- ♦ Enrichment of magnesite mines waste for steel industry

Raw Material for Iron & Steel Industry



- ♦ Flowsheet development for beneficiation and agglomeration of iron ore



- ♦ Clean coal technology for Blast Furnace utility



Some of Our Valued Customers

- Tata Steel, India • Korea Institute of Geoscience & Mineral Resources, Korea • Steel Authority of India Limited, India • Uranium Corporation of India Ltd., India • Nepal Metals Company, Nepal
- Gujarat Mineral Development Corporation, India • Government of India Enterprises
- Government of Syria • Eastern Mining & Metals Co. Ltd., Malaysia • Coal India Ltd., India
- Hamersley Iron Ore Co., Australia • Indian Rare Earth Ltd., India • Government of Bhutan, Bhutan
- Hindustan Zinc Limited, India • Ispat Karmet, Kazakhstan • Government of Uganda



Alternative route to metal extraction from secondary sources

Mineral Processing

Values from Secondary Resources

Processing of waste dump to produce barite product

Processing of BaCO_3 plant sludge to recover barite

Metal values from electronic waste

Ferrite from Iron ore Fines

Recovery of Sulphur from sludge of H_2SO_4 plant

Enrichment of phosphatic soil for acid grade concentrate

Enrichment of magnesite mines waste for steel industry



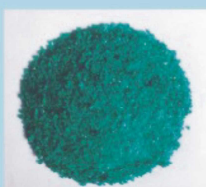
Production of Si-Mn Alloy from the residue of Sea Nodules



Nickel Recovery From Spent Nickel Catalyst



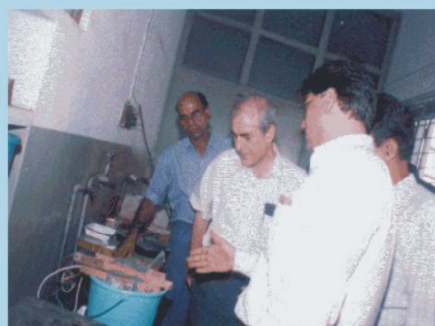
An innovative hydro metallurgical process has been developed at NML to recover nickel as nickel sulphate from spent nickel catalyst with very high yield with 97% overall recovery



Nickel sulphate prepared from spent nickel catalyst



Electrolytic iron powder



Energy efficient and environmentally friendly process. It can be used in powder.

Metallurgical Applications. Recently its bio- application is being explored



Iron making by tribal process was in vogue in the country before the advent of the modern Iron making Process by blast furnace route.

Improvement Tribal Iron Making Process



Iron ore used



Traditional method of tuyere making



Charging Operation



Air blowing by traditional method



Fused mass of iron with slag



Taking out the product



Marketable products



Heat Treating

Flow chart of the iron making process

Preparation of furnace hearth, tuyere and bellow setting for air blast



Charging with charcoal and ore on the top



Ignition of charge



Recharging with charcoal & ore periodically



Slag removal



Collection of iron mass (product)



Hand Forging to squeeze out slags & heat treating for making implements



COMPARATIVE PERFORMANCE

	Traditional	Improved
* Yield	25-30%	50-55%
* Quality of metal (slag content)	15-20%	5-10%

Modified process in use



De-slagging

Alternate to sal wood charcoal



Mahua Char

Tamarind Char



R & D for optimisation of parameters



Ore Beneficiation

EFFECTIVE ADDITIVE FOR BENEFICIATION OF SINTER GRADE FINES AND SLIMES.



Application of surface-active agents

IMPORTANCE

- THE INDIAN IRON ORE MINES GENERATE - 35% FINES. IRON ORE FINES AND SLIME CONTAIN ABOUT 58% FE AND ALUMINA (> 8%) AND SILICA (< 8%).
- SIMPLE PLAIN WATER WASHING OF FINES DOESN'T CHANGE THE Al_2O_3/Fe AND Al_2O_3/SiO_2 RATIOS IN THE CONCENTRATE SIGNIFICANTLY. BLAST FURNACE REQUIREMENT: $Fe > 60\%$, $Al_2O_3/Fe < 0.05$ AND $Al_2O_3/SiO_2 < 1$. IRON ORE WASHING PLANTS PRODUCES 10-25% SLIMES.
- RECOVERY OF THE IRON VALUE FROM LOW GRADE FINES AND SLIME WITH Al_2O_3/Fe AND Al_2O_3/SiO_2 RATIOS BETWEEN 0.05 AND 0.1, RESPECTIVELY ARE ESSENTIAL.
- USE OF TECHNO ECONOMICALLY CHEAP AND ECO FRIENDLY SURFACE ACTIVE AGENTS IS AN ALTERNATIVE APPROACH FOR BENEFICIATION OF IRON ORE FINES AND SLIME. THE SURFACE ACTIVE AGENTS ADSORB ONTO HEMATITE SURFACE RESULTING IN FLOCCULATION OF HEMATITE SURFACES AND DISPERSION OF GANGUE MINERALS RICH IN ALUMINA.

CSIR-NEIST DEVELOPED AN ADDITIVE USING NATUARALLY OCCURRING RAW MATERIAL, WHICH IS ABUNDANTLY AVAILABLE AT LOW COST. A COMMERCIAL SCALE TRIAL JOINTLY WITH RDCIS, RANCHI; ROURKELA STEEL PLANT AND BARSUA IRON ORE MINES WAS GIVEN IN THE JIG CIRCUIT OF BARSUA IRON ORE WASHING PLANT USING 20 T ADDITIVE AT A DOSE OF 0.05 % IN TWO PHASES USING -10 MM IRON ORE FINES. THE NET GAIN ON ADDITIVE WASHING OVER PLAIN WATER WASHING WAS 0.88% FE INCREASE, 7.35% DECREASE IN SiO_2 AND 9.26% DECREASE IN Al_2O_3 . NET ADDITIONAL GAIN OF RS. 4.54 PER TONES HOT METAL PRODUCED.

For details please refer NEIST websites
www.neist.res.in & www.rrijorhat.com



THE PROCESS

COLD BONDED PELLETIZATION OF IRON ORE FINES USING ORDINARY PORTLAND CEMENT BINDER IS EMERGING AS A POTENTIAL ENERGY SAVING AGGLOMERATION PROCESS FOR PROPER UTILIZATION OF INDIAN IRON ORE FINES.



FIG. 1: COLD BONDED IRON ORE PELLETS (PREPARED FROM 'BLUE DUST' OF HIGH IRON CONTENT)



FIG. 2: COLD BONDED IRON ORE PELLETS (PREPARED FROM 'ORE HAVING MODERATE IRON CONTENT')

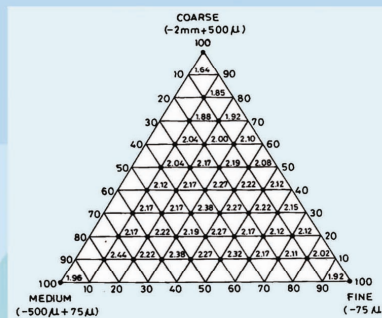


FIG. 3: COMPACTING DENSITY VALUES OF ORES MIX AT DIFFERENT GRANULOMETRY.

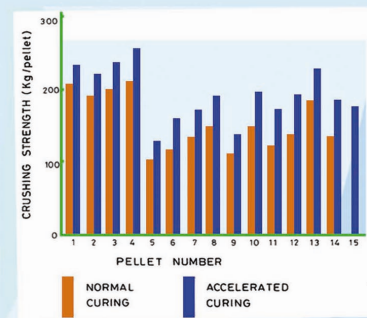


FIG. 4: CRUSHING STRENGTH OF PELLETS CURED UNDER NORMAL AND ACCELERATED CONDITION

IMPORTANCE

- MINING AND PROCESSING OF THE MINERALS GENERATE HUGE AMOUNT OF FINES.
- THE GENERATED FINES REQUIRE PROPER UTILIZATION IN RESPECT OF CONSERVATION OF NONRENEWABLE RESOURCES AND ABATEMENT OF POLLUTION.
- THESE FINES REQUIRE AGGLOMERATION THROUGH SINTERING OR HEAT INDURATE POLARIZATION FOR EXTRACTION OF THE METAL IN THE BLAST FURNACE.
- COLD BONDED IRON ORE PELLETS ARE EMERGING AS A POTENTIAL BURDEN MATERIAL FOR IRON EXTRACTION IN DIFFERENT SIZE FURNACES.

COLD BONDED IRON ORE PELLETS PREPARED USING VARIOUS BINDERS AND CURING UNDER DIFFERENT CONDITIONS ARE SUITABLE AS BURDEN MATERIAL FOR EXTRACTION OF IRON IN DIFFERENT SIZE FURNACES.

For details please refer NEIST websites
www.neist.res.in & www.rriiorhat.com



CARBONIZATION OF HIGH SULPHUR NE COALS:

NON-RECOVERY TYPE OF OVENS FOR HIGH VOLATILE CAKING COALS HAVE BEEN DEVELOPED FOR PRODUCTION OF INDUSTRIAL COKES WITH CAKING COALS OF ASSAM & MEGHALAYA, SUITABLE FOR CEMENT, OTHER FOUNDRY AND DOMESTIC INDUSTRIES. THE DTA CURVES OF DIFFERENT NEER COKES SHOWED SHARP EXOTHERMIC PEAKS SIGNIFYING GOOD QUALITY CLINKERS FOR CEMENT MAKING. THE WASTE HEAT GENERATED DURING THE PROCESS COULD ALSO BE RECOVERED FOR OTHER PURPOSES.



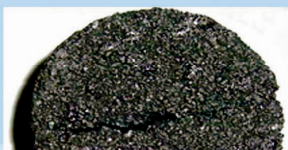
Carbonization in Coke Ovens



NE Coke

UTILISATION OF NON-CAKING COALS FOR DOMESTIC AND INDUSTRIAL SECTORS:

BRIQUETTING/ NODULIZATION OF NON CAKING COALS AND FINES AND CARBONIZATION FORMING LOW VOLATILE FUELS, WHICH WILL LEAD TO ENERGY CONSERVATION & DEFORESTATION



BLENDED COKE
AKHURUSHABA COAL 70%
KONYA COAL 30%
HTC AT 750°C



AKHURUSHABA WASHED COAL
HTC AT 800°C



BLENDED COKE
AKHURUSHABA COAL 70%
KONYA COAL 30%
HTC AT 850°C



CARBONIZED NODULES
AKHURUSHABA COAL
WITH 8% BINDER
AT 900°C

Bio Energy

BIOMASS AND AGRO INDUSTRIAL WASTES LIKE IPOMEA AND BAMBOO KNOTS CARBONIZED IN SCALED UP UNITS, SUITABLE FOR WATER FILTRATION AND OTHER AS OTHER CARBON SOURCES.



PRODUCT YIELD (BAMBOO KNOTS)
CHARCOAL : 23-28 %
TAR: 6-7 %

THE SCALE UP STUDY REVEALS THE POSSIBILITY OF USEFUL PRODUCTS FROM BAMBOO BIO-WASTE. BIO-BLENDS FOR PYROLYSIS AND COMBUSTION HAVE POTENTIAL FOR COMMERCIALIZATION AS AN ENERGY SOURCE.

For details please refer NEIST websites
www.neist.res.in & www.rrlforhat.com

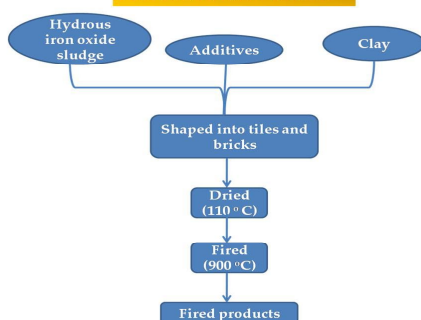


A process for clay conservation in tile and brick sector through a novel blend containing iron oxide rich industrial solid sludge

Value Additions

Clay used for building components is a widely exploited non renewable resource and this also leads to environment issues. The current process is based on development of a specific blended composition of hydrous iron oxide produced by M/s Cochin Minerals and Rutiles Ltd, one of the leading industries in the country manufacturing synthetic rutile for 100% export for value addition to the manufacture of titanium oxide. The disposal of iron oxide in large quantities poses serious environmental problems and NIIST (CSIR) know how is to produce hydrous iron oxide-additive-Master Mix which is a composition that can be added to clays up to about 40% to conserve top soil, and for manufacture of building bricks and tiles.

Process flow chart



Technology transfer to M/s CMRL, Cochin (Kerala).



The process has been optimised, tested under laboratory conditions and further scaled up to industrial levels

Achievements

- The process has been successfully demonstrated.
- The technology is transferred to M/s CMRL, Cochin (Kerala).
- The company has received the Kerala State Award for effective industrial by product utilisation based on this technology.

Production of Synthetic Rutile transferred to CMRL, Alwaye, Kerala

NIIST Technology

- Most environment friendly-low acid consumption byproduct utilization as suitable commodities
- Devoid of ammoniacal nitrogen effluent employed in Becher process
- Synergistic beneficial effect in terms of product quality by combination of unit processes
- Total recovery of iron values from ilmenite
- Tailor-made to raw materials

Client

- Cochin Materials and Rutile Limited (CMRL) is a public limited company engaged in the production quality synthetic rutile (SR) from ilmenite since 1989.
- It is a 100% EDU processing locally available beach sand minerals, ilmenite.
- In order to reduce the consumption of HCl and hence the production of acidic effluents in the present process, CMRL proposed to adopt NIIST (CSIR) Technology

Rationale for the New Technology

- To be competitive in Market
- Sustain the production capacity to meet the customer demand
- Further improvement in quality
- Reduce dependence on HCL
- Convert Solid Wastes to revenue earning usable materials
- Become more Environmental Friendly



Development of Titanium dioxide based self cleaning nano coatings

The technology for the transparent nano coatings of photo catalytic, sun light active titanium dioxide was developed at NIIST (CSIR). The technology package covers the specific compositions of nano titania, the production process, application technique for transparent active nano coatings and further surface modifications, if any required. The functional properties of self cleaning, anti soiling and surface wettability have been introduced in various compositions. The above technology has been optimised for glazed ceramic tiles, demonstrated in laboratory scale and in pilot scale. The technology is being transferred to one of the leading glazed tile manufacturers in the country.

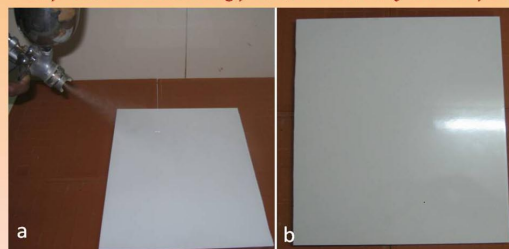
APPLICATIONS

- ✓ Anti-soiling, self cleaning tiles and glass.
- ✓ Fog proof, anti-bacterial, anti-viral, fungicidal.
- ✓ Can be used in making medical devices, food preparation surfaces, air conditioning filters, and sanitary ware surfaces.

Photoactive Titanium Oxide (TiO_2)

Titania (TiO_2) exists in crystalline forms such as anatase rutile and brookite. In anatase the TiO octahedron shares four corners. Anatase titania is photocatalytically more active.

- ◆ TiO_2 when illuminated with light of suitable wavelength produces electron-hole pairs
- ◆ The strong oxidizing potential of the positive holes oxidizes oxygen or organic materials directly.
- ◆ Possess sterilizing, deodorizing and anti-fouling properties



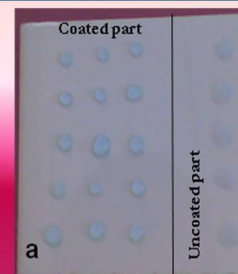
(a) Nanotitania spraying on to the glazed tiles (b) nanotitania coated tile.

Demonstration of self clean ability of nano titania coated tiles by dye degradation



Patches of standard dye methylene blue and rhodamine 6G on the coated tile (a) before exposure (b) after 1h exposure (c) after 2 h exposure, to sunlight.

Demonstration of hydrophobicity



Titania coating on terracotta tiles (Pilot trials)

Future

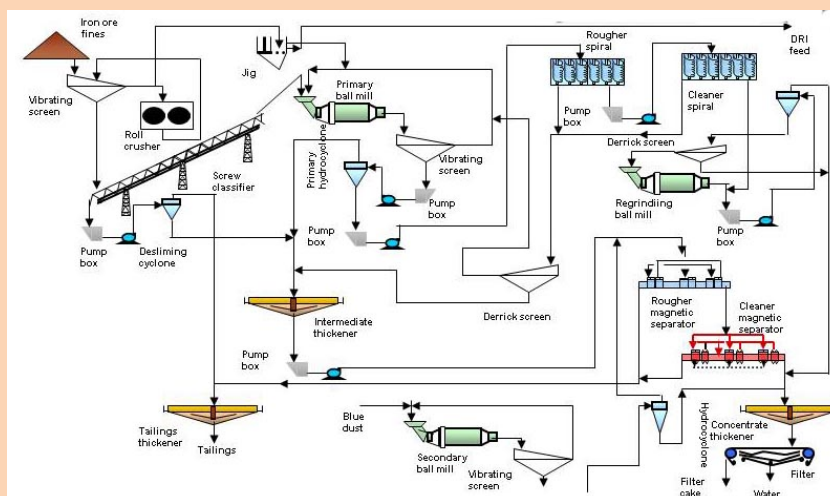
Technology Features

- ◆ Specially developed composites of titanium dioxide for sunlight activity.
- ◆ Coating precursor compositions suitable for ceramic ware.
- ◆ Surface modified compositions for wettable to non wettable surface behaviour.



Processing of Low Grade Fines

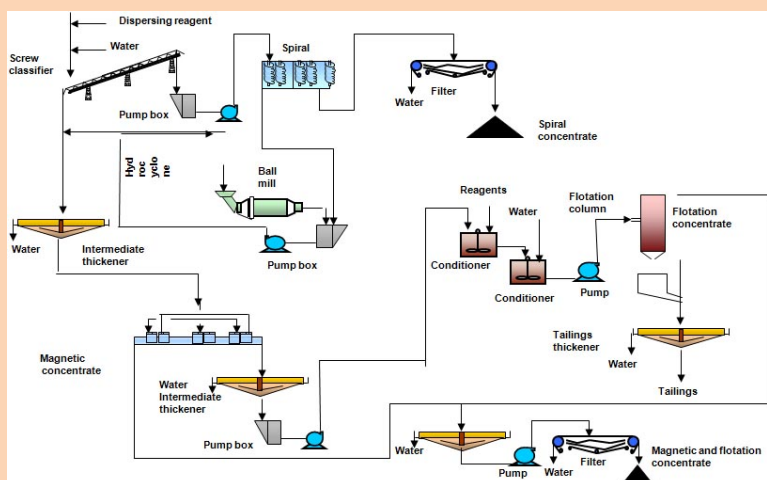
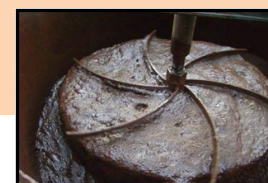
Feed: Fe-% 55-58, Al_2O_3 % – 6-8 %, SiO_2 % – 5-7
Concentrate – Fe% 64-65 Al_2O_3 % – 2-3 %, SiO_2 % – 2-3
Yield – 75-85%



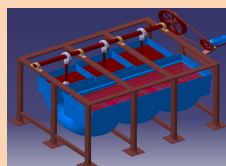
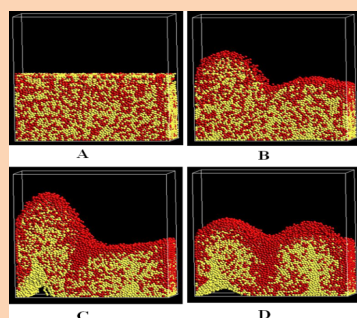
Recovery of Iron Values From Washery Tailings

Washing plant rejects, ~10 MT per annum being discarded could be converted to pellet grade Concentrate

Feed: Fe 50-60%, Al_2O_3 – 5-10 %, SiO_2 – 4-9 %
Concentrate Yield – 50



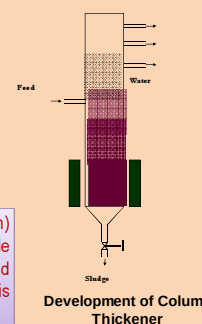
EQUIPMENT DESIGN FOR MINERAL PROCESSING



Development of improved Jig

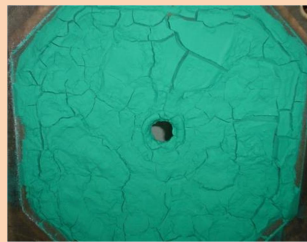


Development of improved Jig



DEM based software called SIMJIG (in C programming and Net platform) has been developed to simulate the jigging process. This simulation code takes into account all the forces that act on the individual particle and calculate the net unbalanced force acting on the particle, which is subsequently used to determine the motion of particle.

Recovery of Metal values from Secondaries



We offer

Process know how
Pilot scale testing
Engineering process packages

IMMT can provide technologies on Turn-key basis

- Copper and Zinc from Spent catalyst, Brass ash and Zinc ash
- Recovery of cobalt from cobalt bearing slags
- Nickel from spent catalyst
- Superfine and white ATH from Bayer liquor
- Battery grade materials such as nickel hydroxide and electrolytic manganese dioxide

Facilities we have

- Atmospheric & Pressure Leaching
- Solid-Liquid Separation
- Solvent-Extraction
- Electrowinning
- Mathematical Modeling & Design
- Membrane Technology and Characterization



Banded Hematite Quartzite Iron Ore

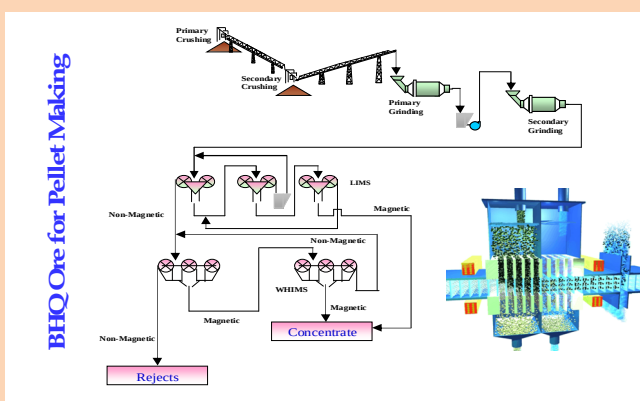
Efforts to utilize BHO in India First time

Feed: Fe% -37-42, SiO₂% 40-45, Al₂O₃ %0.5

Process: Size reduction, Classification and magnetic separation

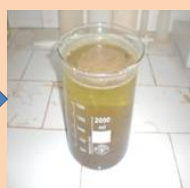
Product: Fe - 63-65 %, SiO₂ -4-6.0, Yield - 37-42%

Break even capacity: 1.5 MT of ROM



Stabilization of Cr(VI) in Toxic Chrome Chemical Residue

Back Ground: Chrome chemical residue is a waste generated from dichromate manufacturing plant. It is a toxic waste and causes Cr (VI) contamination through leaching. Disposal is a major problem for the chrome chemical manufacturing industries in the country. At present any remedial process has not been developed



Cr leaching (< 0.01ppm)



Sintered Di-chromate residue

Cr leaching (< 0.01ppm)

PROCESS IN BRIEF

Homogenization of Chrome Chemical Residue

Homogenized Raw Mix Granulation

Sintering (DDS)

Chromium Stabilized Sinters

PROCESS DEMONSTRATION TO M/S Chrome Chemicals, Chandrapur, Maharashtra



Raw material mix of 50% dichromate residue with additive and coal by grinding and then granulation for sintering treatment



Treatment by down draft sintering (DDS PROCESS) of granulated dichromate mix on 50 kg batch scale for stabilization of soluble chromium