

CHAPTER-VI

RESEARCH AND DEVELOPMENT

Empowered Committee on Research & Development

Research & Development in iron and steel sector is normally being carried out by the steel plants, academic institution, national research laboratories themselves. However, to supplement and encourage research activities in iron and steel sector, Govt. of India is providing financial assistance from the Steel Development Fund (SDF) for some of the R&D projects received from public and private sector steel plants, national laboratories, academic institutions etc. Thrust areas of the R&D projects, so assisted, are given below:

- Design & development of new technologies & production processes.
- Reduction in raw material and energy consumption.
- Development of Human Resources.
- Utilisation of waste materials.
- Environment management and pollution control.
- Development of new value added products.

To obtain the financial assistance, application in 5 copies in the prescribed format available at the website steel.nic.in , Ministry of Steel are to be submitted to Industrial Adviser, Ministry of Steel, Govt. of India, Udyog Bhawan, New Delhi-110011.

Empowered Committee

In pursuance of the decision of Government of India, an Empowered Committee under the Chairmanship of Secretary to the Government of India, Ministry of Steel with members from Department of Science & Technology, Department of Scientific & Industrial Research, Planning Commission, steel producers in both private and public sectors, Indian Institute of Technology (IIT), Kharagpur, National Metallurgical Laboratory (NML), Jamshedpur, MECON Ltd, Development Commissioner for Iron & Steel & Secretary SDF Managing Committee and others has been set up on 24.2.1998 with a view to providing overall directions to the total research effort on iron and steel in the country and approve specific research projects placed before it for funding fully or partially, from SDF.

The terms of reference of the Empowered Committee are as follows: -

- (a) Examine all aspects of Science & Technology in the iron & steel sector.
- (b) Co-ordination of the on-going research programmes in the iron and steel sector (both in the Public & Private Sectors) and monitor their progress.
- (c) Evaluate and decide upon the research proposals placed before it for fully or partly funding from the interest accruals from the Steel Development Fund.
- (d) Review, periodically, the progress of Science & Technology programmes of national importance in the iron & steel industry.
- (e) Advise Ministry of Steel on the policies and programmes which need to be pursued in developing domestic capabilities in scientific and technological research, development of design, engineering and research in the iron & steel processes and products.

Secretariat of the Empowered Committee (EC)

The responsibility for providing secretarial assistance to the EC has been entrusted to the Technical Wing in the Ministry of Steel, Udyog Bhawan, New Delhi-110011. The Technical Wing processes the applications in consultation with an Evaluation Group (EG) comprising of Industrial Advisor, Ministry of Steel; Adviser, Department of Scientific and Industrial Research and Adviser, Deptt. of Science and Technology {at present represented by Advisor, Technology Information Forecasting and Assessment Council (TIFAC)} and other experts in the field and places the applications before the EC for final decision in the matter. The Technical Wing and also the EG and some specifically constituted Empowered Boards (EB) of experts for some high value R&D projects monitor the progress of the research work and report to the EC. On the recommendation of the Empowered Committee, the money is released by Joint Plant Committee, Ispat Niketan (1st floor), 52/1 A, Ballygunge Circular Road, Kolkata-700019 and they also keep check on proper utilisation of funds by the project authorities. In case any deviation is noticed, the same is brought to the notice of the Empowered Committee.

Requirement of Fund

An outlay of Rs. 95.0 crore (RE) is available for financing research and development activities for the year 2002-03.

Since its constitution, the Empowered Committee (EC) has met 6 times and already approved 27 R&D projects. In addition to these, 1 development project has been taken up with the approval of the chairman, EC. The total cost of these 28 projects is Rs.181.89 crores (as on 31.01.03). Out of this, Rs.91.51 crore is to be met from SDF. The year-wise release of money is as follows:-

(Rs. in crores)				
S.No	Year	R&D Projects	Other Science and Technology related projects	Total
1	1997-98	0.04	0.08	0.12
2	1998-99	1.2958	0.04	1.3358
3	1999-2000	32.57475	NIL	32.57475
4	2000-01	16.7577	NIL	16.7577
5	2001-02	8.483	NIL	8.483
6	2002-03 (up to 31.01.03)	0.40603	NIL	0.40603
7	Total	59.55728	0.12	59.67728

Achievements/Benefits from the completed R&D projects.

Out of the 28 projects, 8 projects have been completed so far. In 4 research projects, results are satisfactory and they are yielding benefits to the industries. The benefits accrued in these projects are indicated in the following Table. 3 research projects have been completed but with unsatisfactory results. 1 research project has been stopped by the EC after a review. The completion reports of other 2 research projects have been received and are under examination. Work on the balance 18 research projects are in progress.

SI No	Name of the research project	Benefits accrued
1	Energy efficiency improvement in secondary steel sector in India: by MECON Ltd. Ranchi	By implementation of some of the recommendations given by MECON Ltd in the final report, many Electric ArcFurnace/Induction Furnace based steel plants have been able to reduce energy consumption to some extent. Other recommendations are being implemented to reduce energy consumption further.
2	Develop on line expert system for continuous casting system	Of-line expert system developed by MECON has shown Encouraging results on understanding of the working Environment and automatic correction of operating parameters of continuous casting

	(Billets/Blooms/Slabs)	machines to enable production of quality continuous cast billets. Based on the outcome, the Empowered Committee has approved additional SDF contribution for actual implementation of the expert system in actual operation (on line).
3	Develop a teaching package on structural design for department of Civil/Structural Engineering	The teaching package in civil engineering institutions has been developed with financial assistance from SDF and these are to be utilised in actual practice to improve knowledge and competence of fresh civil/structural engineers so that they can correctly and confidently specify usage of structural steel in construction incorporating the modern development with the ultimate goal of increasing steel intensive construction in India. The implementation has already started and four workshops have been conducted in different parts of the country. Participants found the teaching material very useful for enhancement of the knowledge and expertise in the structural steel design. Further, follow up action has been initiated with different institutions/universities.
4	Simulation of Thermo Mechanical Processing & Hot Workability of High Strength Steel.	The research work has been recently completed and lean alloys (as substitute to conventional costly high alloy steel) have been developed under the R&D project. One alloy has been commercially exploited at Rourkela Steel Plant. The results are very encouraging resulting in savings in the production cost of high strength low alloy steel plates to the tune of Rs 12,000 per tonne.

Research & Development activities by Iron & Steel producers

Iron and steel producers, both in the public and private sector, continued to pursue their research and development activities to deal with their plant specific problems; assimilate and innovate newer technologies; utilise Indian minerals and raw materials in larger proportion; reduce pollution; conserve energy and reduce cost of production.

Total amount of money spent in Research and Development by Iron and Steel Plants and other related industries during last three years were as follows:-

(Rs. in crores)

	2000-01	2001-02	2002-03 (upto Sept.'02)

(a) Public Sector			
Steel Authority of India Ltd.	51.83	49.85	25.71
Rashtriya Ispat Nigam Ltd.	2.50	2.50	1.20
National Mineral Dev. Corp.	5.64	6.39	2.79
Kudremukh Iron Ore Co. Ltd.	4.20	6.50	5.15
Manganese Ore India Ltd.	0.74	0.90	0.36
Sponge Iron India Ltd.	0.06	0.04	0.02
Bharat Refractories Ltd.	0.21	0.33	0.18
MECON Ltd.	0.76	0.40	0.15
Sub Total (a)	65.94	66.91	35.56
(b) Private Sector			
Tata Iron & Steel Co. Ltd.	10.43	7.52	3.60
Mukand Ltd.	0.43	0.25	-
Sunflag Iron & Steel Co. Ltd.	0.45	0.99	1.07
Jindal Vijay Nagar Steel Ltd	0.41	0.33	0.12
Jindal Steel & Power Ltd.	1.86	0.81	0.82
Sub Total (b)	13.58	9.90	5.61
Grand Total (a+b)	79.52	76.81	41.17

STEEL AUTHORITY OF INDIA LIMITED (SAIL)

Research & Development Centre of the SAIL has undertaken **114 R&D** projects during the current year (i.e. 2002-03) out of which 95 projects are to be completed during the year. These projects provide technological inputs to SAIL plants/units with thrust on cost reduction, value addition, quality improvement and development of new projects. 22 R&D projects have already been completed during the period from April to September'2002.

The Centre filed 20 patents and 20 copyrights during 2001-02 and the same number of patents and copyrights are planned to be filed during 2002-03. 4 patents, which were filed earlier, have been sealed by the Patent Office during the current year. In addition, RDCIS undertook contract research work and provided significant consultancy services and know-how to organisations outside SAIL yielding external earning of Rs.46.70 lakhs upto September'2002.

RDCIS also undertook research work under SDF aided projects. Out of five projects of national importance approved by the Empowered Committee, one project has been successfully completed.

Specific areas in which R&D activities were carried out by the SAIL are:

- Quality Improvement
- Yield/Productivity Improvement
- Energy Conservation
- New Technology/Product Development
- Waste Management/Pollution Control

Benefits Derived as a Result of R&D Efforts

Quality Improvement

- Design modifications were made in A&B strands of Wire Rod Mill of BSP, which brought down secondary scale generation in the range 0.84 - 1.24% by accelerated cooling of wire rods. Average coiling temperature was lowered to 770-830⁰C from 880-920⁰C.
- Corrective actions taken to improve shape & productivity of CR coils from Tandem Mill of RSP : improvement in profile of HR coils with requisite strip crown and wedge; maintenance of stipulated value of roll crown; control of roll wear by fixing norms for cycle over tonnage; reduction of thermal camber in work rolls by improved roll cooling; use of modified strip lubrication nozzels; formulation of reduction regimes to achieve uniform mill loading and use of new rolling oil with improved lubricity. Diversion due to bad shape was reduced from 2.2 to 1.5% and rolling rate was increased from 51.5 to 55.0 t/h.
- In order to improve desulphurisation in ladle furnace in SMS-I at RSP, 35 trials were carried out on the basis of a developed process chart. Slag containing 60% CaO, 30% A₁₂O₃ and 10% SiO₂ was found to be conducive for desulphurisation. Lower sulphur achieved in steel was 0,005%. Al consumption in tin plate heats was reduced from 3.58 to 3.02 Kg/t.
- The tertiary type Rolled-In-Scale (RIS) in the HR coils is generated after pinch roll descaler at BSL and gets "rolled-in" the early stands of finishing train. During plant trials, lower hematite content (5.6-7.5%) in scale (compared to 15-30% in normal scale) has been achieved by lowering the F#6 - F#7 interstand temperature of transfer bar surface to 915-930⁰C. Lowering of finishing entry temperatures of the transfer bar has led to significant reduction in diversions due to RIS.

Yield/Productivity Improvement

- A two-tier radio communication system encompassing BF shop and slag granulation plant was designed and installed to improve communication. It has resulted in reduced track time of ladles, lesser heat dissipation and improved yield of liquid slag. The system facilitates better operation, maintenance and safety practices.
- A system for centralized monitoring and control of critical parameters like tar flow, gas flow, heavy oil flow was developed and installed in tar distillation plant#1 at CCD of BSP. The developed man-machine interface software provides historical trending and comprehensive alarm management system.

SDF AIDED PROJECT COMPLETED

Simulation of Thermo-Mechanical Processing and Hot Workability Studies of High Strength Steels

A Dynamic Thermo-Mechanical Simulator (DTMS) and an Electron Beam Wide Area Analyser (EBWA) were installed for carrying out thermo-mechanical simulation and segregation studies, respectively at different processing stages of Nb and Nb-Cu bearing HSLA steels. The major findings are :-

- Developed a lean micro-alloyed steel chemistry (0.1 C, 1.45% Mn, 0.23% Si, 0.015% S, 0.01% P, 0.046% Al, 0.016% Nb) and identified critical parameters for TMCP. Established implication of microalloy additions (Nb/Nb+V : 0.013-0.103%) on phase transformation and recrystallization behaviour (both static and dynamic).
- Developed a lean chemistry alloy (microalloying with Nb and lower Cu:~1.0% and Ni:1.0-1.75%), as a substitute for conventional HSLA-100 steel: processed through direct quenching & tempering to achieve YS>690 Mpa, CVN energy>81J at -84 C.
- Developed a mathematical model to predict austenite and ferrite grain size under varied conditions of hot rolling, and linked it with the tensile properties.

Expenditure on R&D during last three years

(Rs. in crores)

Year	Turnover	R&D expenditure	R&D Expenditure as % of turnover
2000-2001	16233	51.83	0.32
2001-2002	15502	49.85	0.32
2002-03 (upto Sept.02)	8189	25.71	0.31

RASHTRIYA ISPAT NIGAM LIMITED (RINL)

The R&D efforts of VSP are directed towards the following:

- a) Troubleshooting
 - b) Process improvement in the form of carrying out small but decisive changes or addition in the technologies available in the organisation to derive benefits of enhanced efficiency, cost reduction and improved product quality.
1. Continuous study and analysis of data using fundamental process principles and statistical technique to monitor important process

parameters for achieving the results in terms of quality, productivity and specific consumption rates.

- Consolidation of new products developed and further development of new product is done by identifying and interacting with major customers. The new products developed are:-

New Grades

- SUP 9 as billets (75x75) in MMSM
- Fe 500 as micro-alloyed rebar in WRM
- 1065 Cr as 50 & 60 rounds in MMSM
- En 32 B as 25 rounds in bar mill
- C 70 as 16 & 17.5 rounds in bar mill
- En 43 D as 125 square billets
- EN 15 as 63 rounds in MMSM
- CK 45 as 75X75 billet in MMSM

New Sections

- 15, 17.5, 19 & 26 mm rounds in bar mill
- 48 mm rounds in MMSM

Research activities in progress

- Production of high carbon wire rods with improved toughness and drawability
- Improvement of converter lining life to 1500 heats
- Production of EQ grade confirming to IS-2879
- Reduction of specific fuel consumption in sinter plant
- Reduction of ammoniacal nitrogen by nitrification

Expenditure on R&D by RINL

(Rs. in crores)

Year	Turnover	R&D Expenditure	R&D expenditure As % of turnover
2000-01	3436	2.5	0.07
2001-02	4081	2.5	0.06
2002-03	2059	1.2	0.06

NATIONAL MINERAL DEVELOPMENT CORPORATION (NMDC)

The R&D Centre was set up with a specific mandate and the centre has earned a rare distinction of competence of undertaking technology development mission related to mineral processing, flow sheet development, mineralogical studies, agglomeration of ore fines, design of reliable gravity flow silos/bunkers by proper shear testing of bulk solids, slurry transportation of minerals in pipe lines and development of value added products from mine waste.

Utilisation of Mine Waste

Process development for preparation of Zeolite-A from Fluffy Silica obtained from Kimberlite Waste.

Zeolite-A (Sodium Alumino Silicate) is widely accepted as phosphate substitute, eco-friendly, highly effective builder material in detergent and cleaning agents. Given their safe ecological properties, friction and effectiveness synthetic zeolites have been widely accepted as environmentally compatible builders and there has been worldwide shift from phosphate to zeolite-A usage. The water softening action of zeolite-A reduces precipitate formation, thereby decreasing deposits on textiles and on washing machine parts. It gives excellent results in achieving superior and economical wash.

Production of Carbon free Sponge Iron Powder and Development of Value Added Products

The work on development of process for production of carbon free sponge iron powder and value added products there from have been taken up jointly by NMDC and DMRL. The objective of the study is to market about 300 MT of carbon free sponge iron powder, which is proposed to be produced by setting up of a pilot plant of 300 tonnes per annum at R&D centre, Hyderabad.

- **Beach Sand**

Development of Indigenous technology for production of synthetic rutile/pig iron and high pure iron oxide using thermal plasma technology from East Coast beach sand containing about 40-50% Iron. The project is supported by steel Development Fund (SDF).

R&D Centre has signed an MOU with RRL (Trivandrum) & RRL (Bhubaneswar) for setting up of a Pilot Demonstration unit (30 Kg/hr) capacity for production of synthetic rutile, pig iron and high pure iron oxide from ilmenite concentrate of east coast beach sand using thermal plasma technology.

Expenditure on R&D by NMDC

(Rs. in Crores)

Year	Turnover	Expenditure on R&D	R&D Expenditure as % of turnover
2000-01	1012.01	5.6417	0.55
2001-02	1127.00	6.3949	0.57
2002-03 (Upto	541.70	2.2706	0.52

Sept.'02)			
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KUDREMU KH IRON ORE COMPANY LIMITED

Objective of R & D activities at KIOCL are directed towards quality improvement through process development/modifications to suit multiproduct needs and to modify Process Flow Chart to cater to the present run of mine ore characteristic.

Achievements

1. Waste Management utilization of tailings – Value addition

The above project has been taken up with a view to utilize tailings for value addition and resource maximization, attenuate pollution load and to create adequate storage area within the tailings dam for increasing the storage life of tailings dam to discharge tailings supporting exploitation of balance reserves.

The studies have been completed by M/s Roche Mining (MT) Australia who have submitted the final report.

2. Exploitation of primary ore existing below the present deposit

For sustainable mining and longevity, supporting project investment, the above project has been taken up. M/s Metchem were awarded the job of preparation of a detailed Project report for exploitation of primary ore and have completed the study. Final DPR has been submitted by M/s Metchem in October, 2002.

3. Reduction of Silica in final concentrate by fine screening of secondary magnetic concentrate

Studies along with M/s Derrick Screens were conducted for size characterisation of secondary magnetic concentrate using fine screens of 40-mesh size. Studies indicate that at 270-mesh size separation, acceptable level of silica in the concentrate can be maintained.

Project Status:

- | | | | |
|----|--|---|------|
| a) | Total No. of Projects on hand as on 1.4.2002 | - | Two. |
| b) | Number of Projects planned in –2002-03 | - | One. |
| c) | Number of Projects completed in 2001-02 | - | Two. |

Expenditure on R&D during last 3 years**(Rs. in crores)**

Year	Turnover	R&D Expenditure	R&D expenditure as % of turnover
2000-01	583.03	4.20	0.72
2001-02	721.69	6.50	0.90
2002-03 (Sep.,02)	363.76	5.15	1.41

MANGANESE ORE (INDIA) LIMITED

The thrust of the company's R&D efforts is directed towards meeting the challenges of safe and cost-effective mining of manganese ore at increasing depth. The main areas where the R & D efforts of the company have been directed in the recent past and will continue to be directed in the near future are as follows:-

- i) Development of better and improved mining methods
- ii) Development of new support systems in the underground workings and improvement in the existing support methods and practices.
- iii) Development of beneficiation methods and cost effective technologies for the upgradation of ores.
- iv) Development of manganese based chemicals.
- v) Search for value added products and development of methods, processes and technologies for production of the same.
- vi) Exploration of new deposits, feasibility studies for enhancement and upgradation of ore reserves.
- vii) Technology upgradation in specific operations for enhancement of productivity, improvement in safety, reduction in costs and optimisation of manpower used.

On-going R&D for continuous improvement in existing practices:

1. Rock mechanics instrumentation and application of the recent advances in rock mechanics for monitoring the ground behaviour in the underground mines.
2. Pit slope stability studies in the open cast mines, and optimisation of slope angles to reduce the development costs.
3. Blasting studies in the underground as well as open cast mines, for optimisation of blasting parameters, reduction in explosive consumption and blasting costs, and improvement in the fragmentation of the blasted material.

The company's efforts for R&D in its areas of activity and for technology upgradation in its key processes/operations will need to be further strengthened in order to be able to meet the challenges of increasing depth of the mining operations, difficult availability of timber which has been the conventional support

material for the underground workings, and the need for utilisation of low grade ores.

Expenditure on R&D by MOIL

(Rs. in Crores)

Year	Turnover	R&D Expenditure	R&D expenditure as % of turnover
2000-01	165.22	0.74	0.45
2001-02	167.92	0.90	0.54
2002-03 (upto Sep02)	76.55	0.36	0.47

SPONGE IRON INDIA LIMITED

The main R&D thrust given in for the last few years has been to bring improvements in the existing process to the extent possible for effective operation and cost reduction without compromising in the quality of the product and to meet the challenges in the present changing market scenario. This would be continued in future too.

During the year, extensive studies were conducted relating to developmental work towards optimisation of the process of sponge iron production on the iron ores of different qualities received from various mines in Karnataka in combination with coal received from various mines of Kothagudam area. It helped the company to achieve a high capacity utilisation and to reduce specific consumption of raw materials, particularly, coal.

Expenditure on R&D by SIIL

(Rs. in crores)

Year	Turnover	R&D Expenditure	R&D expenditure as % of turnover
2000-01	29.29	0.06	0.22
2001-02	32.26	0.04	0.13
2002-03 (upto Sept.02) (Provisional)	18.40	0.02	0.14

MECON LIMITED

New Processes:

Project entitled "Studies on production of alloyed pig iron and low alloy steel/stainless steel using chromite overburden" is an on going R&D project jointly funded by Ministry of Mines, Ministry of Science and Technology and MECON. Result obtained till date in pilot scale is extremely encouraging. Large scale testing is in progress. This is a process developmental project and the estimated cost of the project is Rs 120 lakhs.

Products:

A : Following products are developed in-house, prototypes made; field tested and commercialized successfully. They were first of their kind to be developed in India.

- Laser Line Indicator System. Two systems have been installed at the Plate Mill of Bhilai Steel Plant in the year 2000.
- Optical Setting Projector. Developed and supplied to Visakhapatnam Steel Plant in 1999.
- CAE software for LT Switches developed and installed at GEC Alsthom, Tata Robins Frazer and Crompton Greaves.

B: Following sponsored projects are completed to the full satisfaction of the respective sponsoring authorities.

- Thermoelectric Cooling Garment for Tank Crew. A DRDO sponsored project. Final tests of the prototype were successfully conducted inside MBT Arjun Tank at CVRDE, Avadi, Chennai in October 2000.
- Initially an off-line expert system was developed to diagnose the quality problems in continuously cast products. The system was installed at Upper India Steels Ltd., Ludhiana and Modern Steels Ltd., Mandi Gobindgarh for billets, RINL, Visakhapatnam for blooms and Rajendra Steels Ltd., Raipur for slabs. Encouraged by the performance of off-line system, Expert system was developed for on-line application with financial support from Ministry of Steel, Government of India. Now, system is under implementation for process control in real time at Modern Steels Limited with financial assistance from Ministry of Steel, Govt. of India.
- In the category of special project, MECON has recently completed a project entitled 'Setting up of Geotechnical Centrifuge Facility at IIT, Bombay. It is a National Facility and first of its kind in India, having capacity of 125-g tonne devoted for geotechnical studies. Many innovative design concepts had been incorporated in the system by MECON. The project is funded by DST, DRDO & MHRD.

Ongoing sponsored projects

- Development of Confocal Microscopy for Biological Applications.
- Miniaturization of Thermoelectric Cooling Unit for Tank Crew.
- Development of LED Opacity Monitor for on-line Measurement of Particulate Emissions.

Most of Product Development activity being aimed towards import-substitution has automatically resulted in cost reduction. Following are few examples:-

i) High Pressure Ammonia Liquor Aspiration (HPALA) System for Pollution Control in coke oven batteries.

This R&D Project was undertaken by MECON and successful trials with prototype nozzles were completed at Bokaro coke ovens. The system was later fully commercialized during rebuilding of coke oven battery no.5 at Rourkela Steel Plant and successfully commissioned in July 2000. The performance guarantees were demonstrated and pollution norms specified by CPCB were established. These efforts have brought in cost reduction of US \$ 110,000 (Rs. 54 lakhs) which otherwise would have been paid to the foreign collaborator as know-how fee.

ii) Leak Proof Coke Oven Doors

This R&D Project is under implementation at Visakhapatnam Steel Plant and the results will be known shortly. This project is supported by Steel Development Fund (SDF). If successful, the leak proof doors will be manufactured indigenously without any outflow of foreign exchange to know-how suppliers. This will effect substantial cost reduction in the future projects and will also ensure compliance with CPCB norms.

Quality Improvement:

The project entitled "Design of 6-Hi Mill" was commissioned at M/s Hero Cycles Ltd., Ludhiana. The development had been rewarded with prestigious "Outstanding In-house R&D Achievements-2000" award by DSIR, Govt. of India. The project was jointly funded by DSIR under PATSER Scheme.

Expenditure on R&D by MECON (Rs. in crores)

Year	Turnover	R&D Expenditure	R&D expenditure as % of turnover
2000-01	273.75	0.76	0.26
2001-02	272.10	0.40	0.14
2002-03 (upto Sept.02)	111.00	0.15	0.13

BHARAT REFRACTORIES LIMITED (BRL)

The Company has carried out R&D in the following specific areas during the year:

1. Mag A1 spinel bonded castables
2. Mag A1 gel bonded castables
3. Development of acid proof bricks & mortar
4. Ladle well mix
5. Air setting cement

6. Inflow mass for slide gate valve system
7. Substituting sea water magnesite with low cost DBM (98% Magnesite) in manufacture of MCB
8. Use of low viscosity novolac type resin suitable for normal counter current mixer
9. Substituting non-corrosive chemicals in place of corrosive chromic acid in masses.

The above R&D work was helped in reducing cost of manufacture as well as development of new products

In line with the constant endeavour to orient its product mix to the demands of the steel plants, the company has given thrust to the development of the following items:-

1. Board of tundish
2. Magnesite bricks with alumina spinel binder
3. Mag A1. gel bonded castables
4. Mag A1. spinel grains
5. Mag chrome aggregate
6. Zirmul castables

(d) Expenditure on R&D by BRL

(Rs. in crores)

Year	Turnover	R&D Expenditure	R&D expenditure as % of turnover
2000-01	60.58	0.21	0.35
2001-02	60.77	0.33	0.54
2002-03 (upto Sept.02)	31.67	0.18	0.57

TATA IRON AND STEEL COMPANY LIMITED (TISCO)

Half-Yearly Report 2002

- A study was successfully completed that resulted in a flow-sheet for the recovery of clean coal from oxidized coal fines to increase the overall clean coal yield.
- Different possibilities of increasing fine clean coal yield at washery -II were explored.

- A project to increase the clean coal yield from flotation circuit by 10% at Bhelatand Washery was successfully completed.
- A model to generate various burden profiles depending on the charging sequences is being developed.
- A project to develop correlation between microstructures and properties of sinter is under progress.
- Design parameters are being developed for non-drainable trough to improve slag metal separation at G Blast Furnace.
- A work has been undertaken with an objective to improve the cleanliness of high carbon steel billets, particularly for the critical applications.
- A project on assessment of the design parameters of the slab caster is on.
- In order to remove the constraint of cooling water temperature difference for high speed casting, a study on redesigning the mould cooling water circuit of slab caster is being carried out.
- Prediction of tapping temperature for direct route heats at LD#2 & SC studies are in progress.
- Simulation is being carried out under different operating conditions to reduce/standardize the treatment time for the RH heats.
- A model is being developed to predict the phase transformation and mechanical property during hot rolling at WRM.
- Development of a model to obtain appropriate profile and flatness of HR coil to reduce the shape defects of CR sheets after cold rolling is under progress.
- Low carbon silicon free grade with phosphorus and watt loss of 5w/kg max. was successfully developed.
- Isotropic steel for bearing cages has been made for the first time and will be supplied to customers through TSSL, Navsari.
- Laboratory trial simulating available CGL #2 heat treatment using Gleeble 1500 has shown the possibility of producing CRDP through CGL #2.
- FEM simulation has been carried out for the forming of compressor shell using ABAQUS/Standard.
- Method for assessing cold work embrittlement test has been established.
- Development of a barrier protection for improving the white rust resistance of GP sheet is under progress.
- New grades of coated products are being developed in line with overseas development and increase in volume of value added coated products.
- A code of practice is being developed for evaluating soundness of back-up rolls of CRM by ultrasonic techniques.
- Study of corrosion behaviour of Tata GA/GP-SP with GP-SP of competitor's products is in progress.

Expenditure on R&D by TISCO

(Rs. in Crores)

Year	Turnover	R&D Expenditure	R&D expenditure % of turnover
2000-01	7814.58	10.43	0.13

2001-02	7607.48	7.52	0.10
2002-03 (Upto Sept.'02)	4034.30	3.60	0.09

JINDAL VIJAYANAGAR STEEL LIMITED

1. Indigenous non-coking coal for Corex

The R&D Project partly funded by Ministry of Steel and Department of Science and Technology to identify suitable Indian non-coking coal for part replacement of imported coal is continuing in collaboration with Society for Innovation and Development (SID), Indian Institute of Science, Bangalore and Central Fuel Research Institute, Dhanbad. Out of the four coal samples, two from Umrer, Western Coalfields and two from Singareni Coalfields, coals from Singareni have been found suitable for use in Corex. Grade 'B' coal from Singareni is to be used directly whereas grade 'E' coal is to be washed.

2. Improvement in quality of Pellets

Based on the laboratory scale studies with alumina, carbon content, basicity and fineness and plant data analysis, controllable parameters were identified and recommendation implemented in plant. The acceptable grade of pellets for Corex has increased from 65 % to 95 %.

3. Iron ore beneficiation

JVSL is going to install an iron ore beneficiation plant with a throughput of 4 mpta iron ore fines. Laboratory scale studies were undertaken for washability characteristics to identify suitable source of iron ore fines. Iron ore fines from six sources were studied and most suitable source was identified.

4. Coal quality for Corex

Based on the R&D work, additional parameters have been identified and added to specifications to coal quality suitable for Corex. The additional parameters identified are heat of cracking, CSR, CRI and chlorine. Further, coal blend specifications have been revised suitably for increased rate of production.

5. Reduction in Tuyere Burning in Corex

Based on the plant data analysis the reasons and parameters for high rate of tuyere burning have been identified.

6. Phosphorus Control in BOF

Optimum slag basicity (3.2 to 3.6) and tapping temperature (1660°C to 1680°C) have been established for efficient removal of phosphorus. Depending on the phosphorous specification, optimum 'Si' in hot metal / slag rate have been worked out.

Expenditure on R&D JVSL

(Rs. in crores)

Year	Turnover	R&D Expenditure	R&D expenditure as % of turnover
2000-01	1345.78	0.41	0.03
2001-02	2000.34	0.33	0.01
2002-03 (upto Sept.02)	1168.82	0.12	0.01

JINDAL STEEL AND POWER LIMITED, RAIGARH

Keeping in view, the company's philosophy for continuous development in technological front and other areas, number of R&D projects were taken up during the year as follows,

- Development of microalloyed steels for high tensile strength and weldability application for special purpose power transmission towers as per requirements of Power Grid Corporation.
- Development of large number of grades for forging /machining applications through castings of 150x150 square blooms and further getting them rolled for auto industry.
- Complete revamping /modernisation of continuous casters (slab & round) for newer and challenging application like high tensile seamless pipes for hydrocarbon industry, boiler applications, oil and automobile sectors etc.
- R&D effort is continued for standardization of operating parameters in order to get ash of required level for rotary kilns and higher yield.
- Constant upgradation of testing facilities with a view to enriching product mix being main objective, addition of state of art technology XRF Spectrometer for blast furnace metal,slag and various ferroalloys and latest gas analyzers (oxygen/nitrogen, hydrogen) are major milestones of R&D effort at JSPL.

Expenditure on R&D JSPL

(Rs. in Crores)

Year	Turnover	R&D Expenditure	R&D expenditure as % of turnover
2000-01	Rs.570	1.86	0.32
2001-02	Rs.648	0.81	0.12
2002-03 (upto Sept.02)	Rs.553	0.82	0.15

ESSAR STEEL

During the last one-year, the major achievements on R&D are as follows:-

- Essar Steel has emerged as a major supplier of hot rolled steel coils of API 5L and API 5CT specification for manufacture of pipes and tubes for the oil and gas industries. Essar Steel has developed and is producing hot rolled coils in various grades ranging from Gr. 'B' to X-70. These had been made possible with optimization of chemical composition of steel for each grade combined with modified thermo-mechanical rolling practice with controlled cooling.
- Essar Steel is one of the few plants in the world to produce ultra low carbon interstitial free steel, through DC arc furnace route. Efforts are made to reduce the carbon further down to less than 40ppm in finished product. The product is well accepted by the customer. Trials for dent resistant IF steel grade are in progress.
- High strength low alloy steels for automobile application have been produced for domestic and overseas market to cater to the needs of the new generation of high tech automobiles. Hot rolled coils and sheets have been produced to JIS and QSTE grades. Good surface quality was achieved by optimization of casting parameters. Essar Steel has also developed and been regularly supplying the steel grades for wheel disc and rim, and long member of chassis.
- Essar Steel has also developed and produced SAE 1541 grade steel for auto components (for front fork of new generation two wheelers). The product is well accepted by the customer.
- Essar has supplied hot rolled steel coils for deep drawing applications such as manufacture of compressor shell for the refrigerators. In the past, these compressor shells were made from cold rolled steel sheets of extra deep drawing quality. Such developments are also bringing down the cost of production for the customer.

Thrust for developing new grades of steel for domestic and overseas market is being made on continuous basis. Essar Steel has taken up new challenges by producing high quality steel coils in demanding steel specifications and in sizes (thickness x width combination) not produced in the country so far and only by a selected few companies capable world wide.

In lower thickness ranges, Essar is supplying thickness down to 1.20mm and width upto 1220mm in low carbon grades as well as 1.50mm and width up to 1200mm in HSLA steel grades (eg. ASTM A607 Gr.50, Gr. 55)

MUKUND STEELS

R&D Achievements during 2001-02

1. Improving drawability of certain grades of stainless steel by standardising cold reduction and achieving desired ultimate tensile strength (UTS).
2. Suitable processing parameters for AISI 400 series of stainless steel wire rods have been developed.
3. Heat treatment cycles for special grades of stainless steel to improve quality have been standardised.

Future Plans

- a) Developing Precipitation Hardening (PH) grade stainless steel to cater to domestic and export market.
- b) Minimising the de-carburization levels in cold heading quality (CHQ) steel grade wire rods to improve quality.

Expenditure on R&D by Mukund Steels

(Rs. in crores)

Year	Turnover	R&D expenditure	R&D expenditure as % of turnover
2000-01	823	0.43	0.05
2001-02	755	0.25	0.03