

● COKE Production with Advanced Coal Conversion Technology (SCOPE21)

I. Backgrounds and Purpose of the Technology Development

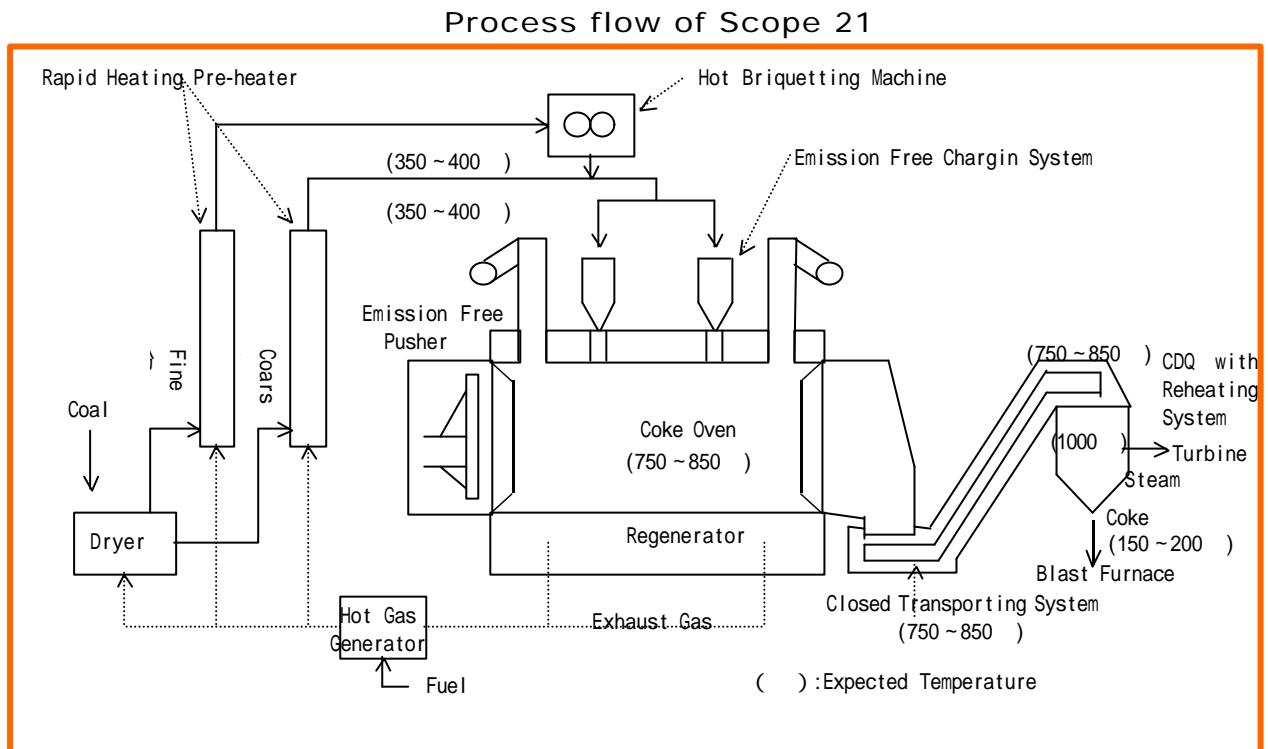
Japanese coke producing industry has been playing a leading role worldwide in the field of coal utilization technology along with the growth of her iron and steel industry . However, **the average age of her existing coking furnaces have reached at around 29 years old since they started their operation. Consequently, it is now presumed that their lives would gradually expire in the coming 10 years or a little later.** Under this circumstance, the ongoing coke manufacturing method holds numerous difficulties such as limited coal resource issues, global environment matters and the notorious coal related working place problems which remind us of the images of coal as representing dirty, dangerous and severe working conditions. In this regard, the industry cannot cope with the possible social requirement in the coming near future, if it sticks only to their replacement of the old furnaces simply by the conventional method.

Regarding the coke producing material, nowadays, coking coal is mostly used for it, which means there is an inevitable restriction of its resource worldwide. And the iron producers can use so much amount of non-coking coal as to 20 % of the required volume by the ongoing coke producing technology. In this regard, a new technology is earnestly requested to flexibly cope with their coal demand in the market, by which **wide range of coals**, from coking coal to non-coking coal, can be practically used. On the other hand, there are some environmental issues such as dusts and black colored flue gases in the coke manufacturing stage, in addition, NO_x and SO_x emissions and some leaking gas treatment should be considered which come from the coking furnace, which all require **drastic environment amelioration technologies**. Furthermore, a new technology is also required, by means of **upgrading the productivity of the coke manufacturing**, to reduce the currently consuming amount of energy for it. The project aims at the technology development as shown below,

II. Positioning of the Technology Development

In these years, 790 million tons of crude steel in total is produced annually in the world, where Japanese crude steel production has amounted approximately to around 100 million tons per year level. In the prevailing crude steel manufacturing in Japan, about 70% of the products comes from the blast furnace-converter method which uses iron ores for its raw stuff, and the rest, 30%, is produced by the electric furnace method which uses scrapped irons for its raw stuff. This ratio may not be substantially changed henceforward. On the other hand, some other new iron producing method such as Coal directly utilizing iron manufacturing technology, called DIOS, has been developed in Japan, which does not use coke at all. In the current time scale

from 2010 until 2020, such new iron producing method without coke will expectedly replace about 20% of the iron production at maximum. However, it is fundamentally anticipated that there will be no drastic shift from the Blast furnace-Converter method to other new method in this forthcoming half of the 21st century. Therefore it is no doubt that we will continuously need coke for our iron and steel industry in Japan.



III. Target of the Development

(1) Effective utilization of coal resources:

Increasing of mixing ratio of the Non-coking coal from 20% to 50%

(2) Environment & energy saving:

Emission level NO_x -30%, SO_x -10%, CO₂ -20%

No smoke, No odor and No dust are also targeted

(3) Higher productivity:

3 times higher productivity and lower installation cost

IV. Content of the Project (Development Points)

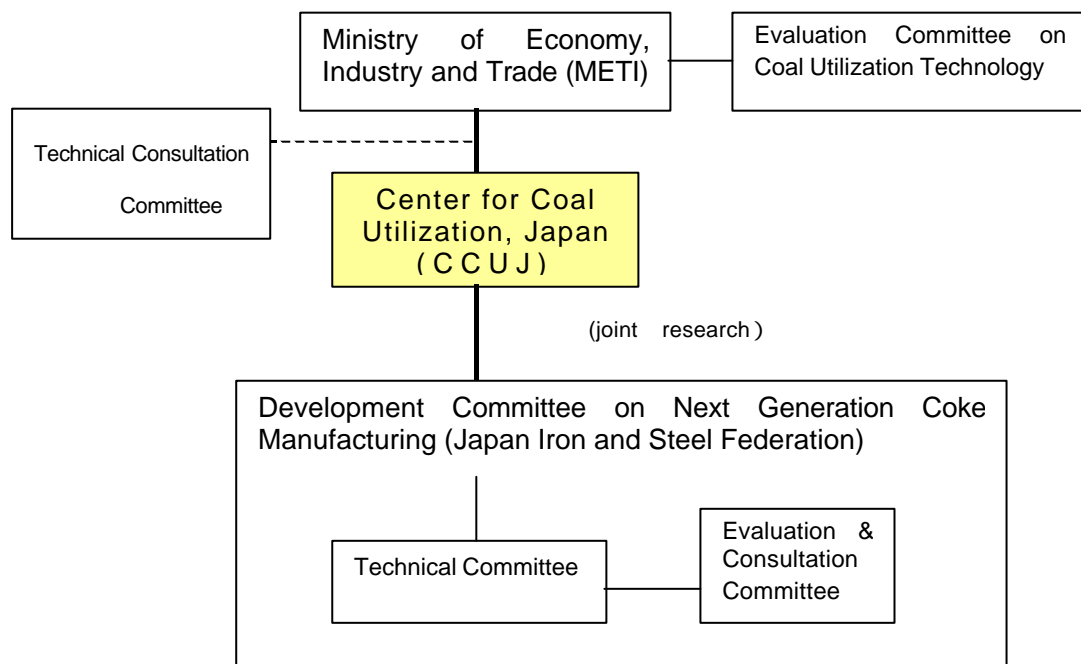
- Establishment of coal quality improving technology by rapid heating
- Establishment of both optimum heating condition during the carbonizing of the coal at medium to lower temperature ranges and improved drawing technology of the coke from the coking oven
- Establishment of upgrading technology of carbonized coke at lower to medium temperatures

- Establishment of both smokeless, odorless and dustless coke manufacturing process and no man controlling technology

V. Development Schedule with Expected Funding

| | FY1994 | FY1995 | FY1996 | FY1997 | FY1998 | FY1999 | FY2000 | FY2001 | FY2002 | Remarks |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| Basic Survey | → | | | | | | | | | |
| R & D on Component | | | | | | | | | | |
| (1) Coal Utilization | | | | | | | | | | |
| Drying/Heating Test | | → | → | → | | | | | | |
| Forming Test | | → | → | → | | | | | | |
| Combination Test | | | | → | → | → | | | | |
| (2) Environment/Energy Saving | | | | | | | | | | |
| Furnace Optimization | | | → | → | → | | | | | |
| Material Handling | | | → | → | → | | | | | |
| (3) Higher Productivity | | | | | | | | | | |
| Upgrading Test in low, medium temperature | | → | → | → | → | | | | | |
| Test using pilot Plant | | | | | | | | | | |
| (1) Planning, Engineering | | | | | | → | → | → | | |
| (2) Installation | | | | | | → | → | → | → | |
| (3) Test | | | | | | → | → | → | → | |
| (4) Supporting Research | | | | | | | → | → | → | |
| Study on Total System | | | | | | | | | → | |

VI. Development and Evaluation Framework



Participants:

Kawasaki Steel, Kobe Steel, Nippon Steel, Sumitomo Metal Industries, Nakayama Steel, Nissin Steel, NKK, Kansai Heat Chemical, Nippon Steel Chemical, Sumitomo Metal (Kokura), Hokkai Steel, Mitsubishi Chemical

VII. Prospect of Commercialization

The project could not but become extended one year from the initially scheduled completion year FY2001 to FY2002, due to extension of installation work of the Pilot Plant facility caused by the delay of development of the pulverized coal forming technology, which needed the Component combination tests (BP tests) for the long period from 1998 to 2000. However, the project has proceeded smoothly since establishment of the pulverized coal forming technology. It is anticipated that the project would be satisfactorily accomplished in FY2002 as re-scheduled. Start of engineering work for commercial plants is the next step after completion of the project.