

# Why Longwall in India has not Succeeded as in other Developing Country Like China

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*The phenomenal growth of the Indian Coal Mining Industry was entirely due to opencast mining which proved to be more productive and economical to cope with the growing demand of coal. With economic liberalization and consequent reduction of import duty on coal, India can no longer rely on opencast mining alone. Introduction of broad scale mechanization in underground coal sector which otherwise remained stagnant has become imperative with an aim to improve the overall quantity of coal and to bridge the increasing demand-supply gap of coal. This paper is an attempt to assess the perspective of mass production technologies including Longwall technology in underground coal mining sector by analysing its prospects and constraints and comparing with the situations prevailing in other developing nations like China.*

**Keywords :** Longwall; Opencast mining; Coal seams

## INTRODUCTION

Since its nationalization in 1973, the Indian Coal Mining Industry has shown a phenomenal growth, but almost the entire growth is on account of opencast mining. The production from underground coal sector has remained practically stagnant for the last three decades. The technological upgradation in underground mining methods in India during this period was very marginal due to inadequate investment and lack of any serious approach for its development. To cope up with the fast growing demand of coal, entire attention was given to the comparatively easily available option of opencast mining which proved to be more productive and economical. The underground mines have practically remained at very low level of production and productivity and sustained themselves by eating up the profit gained from the open cast mines.

With economic liberalization and consequent reduction of import duty on coal, the coal mining industry in India is facing a new challenge and India can no longer rely on opencast mining alone. Introduction of broad scale mechanization in underground coal sector in India has become imperative considering the following aspects:

- i) Making the underground coal mines technologically and economically viable with radical change in production and productivity level from underground mines by producing good quality coal with low ash content from comparatively deep seated deposits at globally competitive price. The economy of underground mines deploying intermediate technology with SDL, LHD, roof bolting and conveyor system as main coal evacuation system is also gradually losing its economic ground due to constantly increasing wage structure and its limitation in production-productivity level owing to cyclic nature of such technology.
- ii) Necessity of striking a balance between production of coal from open cast sector and underground sector with an aim to improve the overall quality of coal and also considering the gradual depletion of opencastable reserves and the more and

more stringent environmental implications in opencast mining.

- iii) Requirement of bridging the constantly increasing demand-supply gap of coal during the present and next five year plan periods and further.

In this context, it is required to assess the perspective of mass production technologies including Longwall technology in underground coal mining sector and make threadbare analysis of its prospects and constraints and make a comparative study with the situations prevailing in other developing nations including China.

## THE LONGWALL MINING SCENARIO WORLD-OVER WITH PARTICULAR REFERENCE TO CHINA AND INDIA

Presently India ranks third among the coal producing nations after China (no 1) and USA (no 2). Some of the excerpts from the report of the International Longwall census conducted in the year 1997 is given below:

Powered support Longwall technology contributes nearly 50% of the global production of coal from underground mines and is the most prevalent methodology in the leading coal producing countries. According to the International Longwall census done in 1997, on an average the production of coal from Longwall mining continues to grow. Following are some of the excerpts from the report of the International Longwall census:

- i) UK is the twelfth ranking coal producing nation with an annual output of 54.1 Mt in 1997, out of which 37.6 Mt came from UG mines. Major part of the UG production was from 26 Longwall faces.
- ii) Ukraine is the eleventh largest coal producing nation. Despite the fact that at present Ukraine is going through a serious phase of economic crisis it is still a major energy producing nation. In 1997 Ukraine had 422 Longwalls each producing on an average 1000 TPD.
- iii) Kazakhstan holds tenth position in the world in production of coal. About 15% of the nation's entire production (72.6 Mt in 1997) comes from underground mines and that is totally from Longwall mining. As per the census total number of operating Longwalls in Kazakhstan is 40.

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- iv) South Africa is the seventh largest coal producing nation with a production level of 222 Mt in 1997. Underground production is 117 Mt out of which Longwall accounts for only 11.9 Mt from 6 LW installations, *ie*, only 10% of the total UG production. Wider use of LW mining in South Africa is in doubt for many reasons including very shallow seams, tough cutting conditions, low level of technical expertise, low level of productivity and capital constraints.
- v) Germany ranks sixth in world coal production. Total production of hard coal in Germany equaling 47.9 Mt in 1997 came from UG mines with almost 100% contribution from 68 operating LW faces. At Friedrich Heinrich mine, Rhineland the average production from a LW face was 8189 Te per day in a seam height of 1.4 m.
- vi) Russian Federation was the fifth largest coal producing nation in the year 1997. During the Soviet Era Russia was one of the highest producers of coal from Longwall mining. Lack of investment has changed the scenario and the number of faces have steadily declined from 432 in 1995 to 296 in 1997 and by 2000 it has further come down to 160. However, the major output of underground coal in Russia comes from Longwall mining.
- vii) India was the world's fourth largest (presently no 3) coal producer in 1997. The International Longwall census report says that 'early efforts at Longwall mining in India were poorly implemented, but experience, better equipment specifications, and improved infrastructure have increased the chance of success. Today in India, there are examples of moderately successful mechanized longwall faces, which produce an average 1500 Mt per day.'
- viii) In Australia, which was the third (presently no 6) largest coal producing nation in the world in the year 1997, the production from 33 Longwall mines was 62.5 Mt in 1997 which accounts for an increase of 13.7 % in comparison to previous year's growth rate of 5.2% (1996). The average seam thickness for all operating Australian Longwalls is 2.84 m (min : 1.8 m; max : 4.5 m) and the average depth is around 312 m (min : 25 m; max : 550 m). Output per employee per year for 1997 was 8350 Te.
- ix) The US coal industry is the second largest in the world producing 1088 Mt of coal in 1997, out of which 383 Mt were produced from underground mines. According to 1997 census, the number of operating Longwall faces in USA was 65. The average depth at which the LW faces operate is 364m (min : 61 m; max : 823 m) and the average thickness is 2.1m (min : 1.09 m; max : 3.6 m).
- x) Today China is the world leader in the field of coal production. In the last two decades the growth of Chinese coal Industry is phenomenal. Similarly, as in India, the Longwall technology was introduced in China in late seventies and early eighties, but unlike India, during this two decade period, Longwall mining has made tremendous inroads in China's coal mining industry. According to the 1997 census report, the coal industry in China comprises three segments; central government owned mines, which account for 46% of production; state owned but locally operated coal mines, mostly small and medium in size and producing 17% of output; and privately owned coal mines

owned by individuals or villages, which account for 42% of total production. In 1997 China produced 1.35 billion Mt of coal. Longwalls with single entry gates account for about 85% of total underground production. Room and Pillar mining is less than 5%. The central Government owned mines have approximately 1400 Longwall faces, and the privately owned village mines have around 2000 hand worked Longwall faces. Of these, 240 fully mechanized Longwall faces provide the greatest interest and account for 18% of all the Longwall faces operating in central government owned mines. For the 20 best faces in China the average width of face is 173 m (the widest face 210 m); Average panel length 1228 m (the longest 1700 m); Average seam thickness 4.8 m (min : 2.8 m; max : 8.5 m). Most Longwalls in China are operated at depths between 300 m and 400 m. With the high seam thickness, 50% of the 20 best Longwalls use sub-level caving method. The average production rate for those 20 faces is 2841 Mt per shift.

#### **A BRIEF REVIEW OF LONGWALL MINING IN INDIA**

As a global phenomenon the pace of technological change had been especially rapid in the second half of the last century, when mechanization of unit operations led to the development of Longwall technology on the concept of mass production in coal mining industry. It was also aimed at reducing the drudgery, monotony and dangers of work persons engaged in underground mining operations. The development of mass production technology including Longwall equipment, continuous miners, ploughs and Shearer loaders have been accompanied by a series of incremental and sometimes radical and innovative developments in roof supporting and coal evacuation systems. India also as a general rule followed the world trend and in 1975 'Project Black Diamond' envisaged introduction of 130 powered support Longwall (PSLW) faces by the year 2000. In initiation of such programme the first fully mechanized self-advancing PSLW face was introduced in Moonidih mine in Jharia Coalfield in 1978.

Subsequently more mines were planned with PSLW in the eighties, namely, East Katras ( BCCL), Seetalpur, Dhemo-Main, Jhanjra, Khottadih (all in ECL ), Patharkhera (WCL) and Churcha (SECL), and also a few mines in the Singareni Collieries Company Limited. In the process about 30 PSLW sets had been imported from different sources in different countries like, UK, Poland, Russia, Germany, France and China.

Barring a few exceptions, where the powered support Longwall faces gained moderate success, most of the Longwall faces in India were far from the desired level of production and productivity on sustainable basis. Moreover further large scale introduction of Longwall technology received severe setbacks due to its successive failures at Churcha (SECL) and Khottadih (ECL) mines. At present in India, Longwall mining accounts for a meagre production of about 4% of the total underground production.

#### **FACTORS AFFECTING THE EFFICIENT AND ECONOMIC USE OF LONGWALL MECHANIZATION IN INDIAN UNDERGROUND MINES**

##### **No Policy for Introduction of Mass-Production Technology**

Even 28 years after nationalization, there is no policy for mass production technology, *ie*, Longwall, continuous miner with shuttle cars etc. Because of lack in firm policy for mining technology in India, no private/government company has come forward for manu-

failure of underground mining equipments for mass production technology.

In India, there is no standardization of Longwall equipment. As such, all the longwall equipment purchased in India are of different specifications with the result that no manufacturer has come forward for manufacture of Longwall spare parts. Delay in procurement of spares affects production from Longwall panels.

#### **Improper Planning Leading to Wrong Place of Application**

- (i) It is extremely important to choose the proper place of application for freshly mechanized Longwall technology, which is capital intensive and involves a lot of time and manpower in installation, salvaging and shifting of equipment. Therefore, for the proper application of this technology large block / area of coal are required which should be free of frequent geological disturbances or other obstructions. Today the world trend is to provide longer and wider panels to minimize the number of shifting.

In India one of the reason for poor performance of Longwall technology is non-availability of long panels either due to the areas having number of faults or dykes or due to surface features to be protected or due to presence of standing pillars in an upper seam yet to be extracted. This has resulted in frequent shifting of equipment and increase in non-productive work and time.

- (ii) In some cases, Longwall technology at its very initial stage was introduced in extremely difficult geo-mining conditions such as steep seam having less thickness at great depth with very high ambient temperature and strata and Degree-III gassiness. Yet in another case, the coal evacuation system was extremely circuitous with a series of conveyors. This factor proved a serious bottleneck in improving productivity from these Longwall faces.

This type of improper planning adversely affected the performance parameter of the Longwall technology in Indian context at its very budding stage and gave a wrong signal as if the technology is not suitable in Indian mining conditions.

#### **Lack of Proper Infrastructure Facility**

In majority of the situations, Longwall technology in India were introduced in existing mines which were not having sufficient infrastructure to match the desired level of production. Provision of matching infrastructure were either delayed or never came up at all resulting in low productivity from Longwall mines and ultimate de-rating of the projects. The infrastructure includes ventilation, coal evacuation, material transportation systems etc.

#### **Lack of R&D Facility Leading to Strata Control Problems**

The most glaring example in this regard are failures of powered supports at Churcha (SECL) and Khottadih (ECL). In both the cases the supports collapsed after failing to withstand the load provided by superincumbent strata during periodic weighting. The superincumbent strata was massive in both the cases and were having 'cavable with difficulty' characteristic. The load therefore was very high and the support systems were underrated. These two incidents gave severe jolt to the programme of large scale introduction of Longwall technology in other Indian mines.

#### **Non-availability of Tailor-made Equipment Suitable for Particular Geo-mining Condition in the Mines**

Due to lack of study and inadequacy of data related with the specific geo-mining conditions of the mine, none of the Longwall equipments imported from different sources were tailor made to adjust to the mining operations in accordance with the specifications of available Longwall equipment. This has adversely affected the production potential of the mines and lowered the capacity utilization of the equipment.

#### **Lack of Proper Training Facilities and Failure to Generate Required Skill**

In order to operate efficiently and adopt hi-tech Longwall mining, it is required to pertain proper training not only for development of technical skill, but also to bring transformation in total quality of workforce by attitudinal change and empowerment. This involves gradual upgradation in knowledge level, of work persons and involving them in decision making processes and providing access to relevant and important information. However, there has been failure in this respect and wherever high mechanization has been introduced, these mines are exclusively executive oriented and proper team work required for success of such technology has not been built up.

#### **Policy Failure to Develop Proper Cadre Scheme Suitable for High Mechanization**

This is one very important area, since it is directly related to motivation of the work persons working with high mechanization. When speaking of hi-tech work persons, their quality is to be enhanced. Development of their self esteem may be an important motivational factor. It is important to recognize their skill, effort for which a separate cadre scheme needs to be introduced.

#### **Dependence on Import Items due to Failure in Developing Efficient Indigenous Vendors, the Longwall Equipment and Spares**

This is one area in which Indian Longwall mining is seriously lagging. Indian manufacturers are not motivated to develop indigenous vendors due to, very limited scope in the background of extremely small demand of the items and non-standardization of the equipment which have been procured from different sources.

#### **Lagging in Certain Technical Aspects, Associated with Longwall Technology**

For improved result from Longwall technology, the following technological processes are required to keep at high pace

- i) Lagging in the pace of development of gate roads and formation of panels.
- ii) High time taken in transportation, shifting and installation of heavy Longwall equipment at face.
- iii) Lagging in providing proper supports in gate roads due to inefficient supporting systems like hand held drilling for roof bolts etc.

#### **SUCCESS OF LONGWALL TECHNOLOGY IN CHINA**

China also introduced Longwall mining in the late seventies and early eighties as in India, but within 20 years it has not only emerged as the world leader in coal production, but has established itself as the largest user of Longwall technology in underground mines and has created for itself an international market for export of Longwall technology, expertise and equipment.

Analyzing the success story of Chinese Longwalling, the following points emerge as important factors for the success

- i) China from the very beginning as a policy adopted wholesome approach for large scale Longwall mechanization in their UG mines. Their approach was very methodical and it took into account their own social and economic conditions. Instead of instantaneously jumping into hi-tech mechanization only in some isolated mines, they introduced Longwall technology stage by stage with incremental technology development. Today also the Chinese LW production comes from three different sectors and fully mechanized hi-tech PSLW technology account for only 18% of the total UG production from 240 fully mechanized Longwall faces, whereas, the total number of Longwall faces in China with medium technology or with hand held support systems is around 3000.
- ii) China has developed tailor made equipments suitable to their conditions. For this they have first generated skilled workforce of Engineers, operators, designers, research institute personnel and manufactures to discuss and decide the particular designing of equipments. They give greater emphasis on applied R & D for product design and quality development.
- iii) China has developed huge infrastructure at unit levels as well as central levels. The infrastructure not only includes technical aspects like ventilation, coal evacuation dust suppression, equipment transportation etc, but also a large number of welfare and environmental amenities like manufacturing of cap lamps, fabrication work, nursery, running restaurants, proper communication, power generation and a series of other activities.
- iv) For achieving high productivity and greater efficiency China has at present set a trend to construct a number of new highly productive and efficient mines with different capacities based on seam/geological conditions by identifying suitable coal blocks in advance. They are also trying to increase the mining height in single lift along with continuation of multi-level slicing method in thick coal seams.
- v) China is improving its metallurgy for indigenous manufacture of powered supports with higher support resistance, more powerful shearer, AFC and belt conveyors for use under hard roof conditions as well as for achieving higher productivity by increasing the panel dimensions, extraction heights and depth of web.
- vi) The development rate in China has tremendously improved. The drifting of rock in China has attained a monthly advance rate of 260 m in hard rock, fractured strata or fault zone. The future development in China made roadheaders is aimed at high powered heads for large section with laser alignment and micro-computer processing technology and high pressure water jet for dust suppression.

## CONCLUSION

Introduction of fully mechanized Longwall technology was made in China and India almost simultaneously. No comparison between these two developing nations can be made in terms of the success parameters. The basic factor is the difference in attitude and determination to go ahead with this globally accepted technology.

Certainly, there are some inherent difficulties in Indian geo-mining conditions, specifically due to presence of hard roof over many coal seams. China is also not free of such problem. This can be overcome if proper studies of strata behaviour and loading pattern on supports systems are made and supports are designed accordingly. Hard roof management techniques are also probable solutions to such problems.

In India introduction of Longwall mining as a method of underground mine mechanization, requires a study of the Chinese experience, which has a lot of common features with India

- a) Identification of suitable blocks/areas of coal where Longwall equipment can be introduced in substantial number.
- b) Proper equipment for specific geo-mining conditions of the mines should be identified and a tie-up should be made so that equipments are manufactured in India along with spare development and proper servicing facilities. Initially, only 3-4 types of longwall equipments may be standardized considering the geo-mining condition in Indian coal industries and action should be taken for manufacture of equipments along with the spares in India. This besides reducing the capital investment for the manufacturer, will reduce the inventory at the projects.
- c) To increase the factor of safety to 1.5-2.0 in place of presently accepted norm of 1.3 for required support resistance calculation for equipment choice till sufficient experience is gained on Longwall technology in Indian conditions. Such high factor of safety will take care of inexperience of work force, system deficit and unforeseen geological disturbances. Also systems for hard roof management are to be evolved for massive strata condition.
- d) For developing skilled and motivated workforce with proper training in technology, radical change in life style, environmental conditions at workplaces and at home and also more involvement in decision making should be envisaged. This would help in change of attitude among people engaged in hi-tech resulting in better teamwork.

Adoption of mass producing technology including Longwall technology has become imperative in India for working deeper seams and also to produce coal at competitive price. Therefore, a well-decided policy for its en-masse introduction has become urgent instead of piecemeal trials.