

The question, Can steelmaking be done continuously?, can no longer be asked. The question now is, Under what circumstances will continuous steelmaking make sense? As to a major problem of continuous steelmaking—production scheduling—the advent of continuous casting in its present batch form has added new dimensions to production scheduling problems. Nevertheless many companies are already scheduling continuous casting machines on a day-to-day basis.

Is continuous casting the wave of the future? Can all steels be continuously cast as readily as they can be ingot cast? Will all steel production in all steel mills be continuously cast at some date in the future? If so, when? If not, why not? And if so, who is going to supply all the equipment, the engineering know-how and the capital if this new process wave sweeps the industry?

About 35 production casting units have been installed in the U.S. in the period from 1960 to 1968. These machines are the ones which will be able to cast the 13 million tons in 1969. Most varieties of steel are (or will be) cast, from concrete reinforcing bars through high quality carbon steels, alloy constructional steels, and flat rolled products of all types including plates, sheets and strip of both carbon and alloy types. (Hardenable alloys are still not castable on production basis.)

As with all other steel mill equipment, the capital cost of continuous casting machines vary according to what is included in the "machine." Based on published capital costs of equipment for steel plants such as Phoenix Steel, Tennessee Forging Steel, etc. it seems \$15 per annual ton of capacity is the casting machine's share.¹ This adds up to \$200 million spent since 1962 for the 13,200,000 tons of installed casting machines. This sum represents about 2% of capital investment by the U.S. steel industry during the period '62 to '68.

As to the immediate future, the most optimistic continuous casting enthusiast does not believe that as much as 50% of steel can be made by continuous casting. Yet, a sober analysis of possible installations, company by company, indicates that some 30 million tons of casting capacity could be under contract in the period of installations 1971-72, less than five years from now. This possible addition to the 13 million tons already being cast today would give 40 million tons of continuous casting capacity at the start of the process' second decade in 1972. Such casting capacity will represent about 25% of 1972's raw steel-making potential, a not unreasonable proportion. The machines will cost \$500,000,000 a figure representing about 10 percent of steel industry capital investment to 1972. This proportion of capital investment would be readily tolerable to an industry spending at a \$2 billion a year rate.

Why has continuous casting suddenly caught on?

Low cost increase in capacity is the key reason why continuous casting machines figure so high in steel industry plans today. How this need for increased capacity works can be most readily seen in the recent history of small steel plants in the U.S. In the carbon and low alloy steel products field there are 33 steel plants in the country each with annual raw steel capacities less than 200,000 net tons. (See table at end of article.) These plants have a combined capacity of 3.6 million tons of steel, representing less than three percent of total U.S. steelmaking potential. Yet these 33 plants have 15 of the 35 production continuous casting machines in operation (or under construction) in the U.S.

Quite clearly, continuous casting represents a major breakthrough in production layout. Many small plants have been built around a continuous caster as their only semi-finished production unit. Such plants are based on scrap remelting using electric furnaces of less than 30 ton capacity. Rolling is generally done in roughing mills of 18 in. size with finished bar (usually hot rolled, rebars and light angles) rolled in 12 in. cross country mills. Prior to the advent of continuous casting machines, these plants cast billet size ingots. Continuous casting practices for these hot rolled bars and structural plants result in a major saving through increased yields. In addition, continuous casting machines make a more nearly continuous steelmaking practice with advantages in quicker scheduling and lower cost operations throughout. Finally, it is easier for a small steel-maker to make higher quality products by continuous casting than with billet ingots.

¹ Capital costs per annual ton of capacity will be less than \$15 as machine capacities become greater, and designs less complex. Nevertheless, 33's survey indicates that \$15 is a useful order-of-magnitude cost figure.