EXCLUSIVE

Plasma Technology Applied To Steel Production In East Germany

As Brazil returns to essentially seventeenth-century methods of iron production using charcoal from trees, the steel industry is experiencing a transition to genuine space age technology in East Germany. In the first large commercial scale application, the DDR steel industry is using plasmas in steel production to achieve a significant saving in energy and to improve working conditions — when compared to the presently used electric arc furnace.

The DDR method makes use of the much higher temperatures and heat transfers of a plasma-electric furnace to reduce and purify metals for steel production. The significance of the process, aside from the already mentioned advantages, lies in the technological experience gained in the transfer to a more highly developed productive technology. Knowledge gained in the implementation of the plasma furnace will be directly transferable to new techniques as the world economy shifts to fusion as its primary energy source in the late 1980s and 1990s. The action of plasmas on molten metal alone will add necessary knowledge for the rapidly approaching era of inexpensive, high energy plasmas. The article translated below appeared in Neues Deutschland, *the official daily of the German Democratic Republic (DDR), on January 22.*

In our January 7 issue we reported on a "world premiére." The heat function tests were begun on a 30-ton plasma smelting furnace at the "May 8, 1945" high quality steel works. This is the only such plant in the world for high-efficiency metallurgy. The development of the plasma smelting technology, the design and construction of the required smelting unit, are all results of close cooperation between the GDR and the USSR. A member of our editorial staff, Dieter Brückner, spoke with Dr.-Ing. Franz Müller, scientific coordinator from the Ministry for Metallurgy, Ore Mining and Potash who has worked on the development of the new process from its inception, about the operation and significance of this scientific and technological feat.

ND: The steel production methods used the most up till now include the Siemens-Martin process, the converter and the electric steel process. What entitles primary plasma smelting to be described as a completely new technology in metallurgy?

Dr. Müller: Ever since human thought began, metallurgists have sought to use the highest temperatures possible in their smelting units. They attempted to achieve this through the use of wood and charcoal, and then went through hard coal, coke, gas and oil all the way to electric current and oxygen gas. In this way, over the course of millennia smelting temperatures were pushed up higher and higher until the maximum limit seemed to have been reached at 3600 Celsius. However, by putting plasma to use as an energy source — plasma, which only occurs in nature in the form of the northern lights and ball-lightning, aside from in outer space — it has now become possible to attain 15,000 Celsius instead of the old 3600. That is really a technical revolution in metallurgy.

ND: Plasma — often described as the fourth state of matter — is created artificially, then. This extraordinarily high temperature must certainly have to be controlled. How is this done? What actually happens inside this plasma furnace?

Dr. Müller: An aimed electrical impulse is sent into a gaseous atmosphere. In this specific case it is argon which is ionized in this fashion. A "plasma cloud" is thereby formed between the cathode and an anode located in the center of the furnace. The high temperature of this plasma cloud are then used to directly smelt the solid materials which have been inserted into the furnace — i.e. high-quality steel scrap and additive materials. To do this it was necessary, for example, to construct plasma burners with a capacity not in existence before now, namely for current strengths up to 10,000 Ampere.

ND: The plasma furnace reminds us superficially of the electric arc furnace....

Dr. Müller: ...but there are also significant differences. For example, while the electric arc furnace works with vertical graphite electrodes, the 30-ton plasma furnace works with plasma burners set in the side. In order to tame the plasma energy with its high temperatures, completely new solutions had to be found for energy distribution. The same solutions had for such parts of the process as the smelting mechanism, the energy transfer, the thermal stress of the furnace elements, etc.

ND: Up until now the world's high-quality and stainless steel has been produced almost exclusively in electric arc furnaces. What will be the new advantages of plasma smelting?

Dr. Müller: There are extraordinarily many. But before I name the essential ones, let me emphasize once more that here we are talking about the smelting of high-alloy steels, and all the following information on the 30-ton plasma furnace's performance refers to comparisons with arc furnaces of the same capacity.

The extraction of allowy metals from the inserted scrap is raised. With chromium, manganese, molybdenum, wolfram and nickel, purities of up to 100 per cent

are achieved. In addition, the iron output rises by two per cent in comparison with the arc furnace. For every ton of quality steel about 60 Kilowatt-hours less electrical energy is needed. Steels and alloys with extremely low carbon content can be produced, e.g., high-alloy welding material and quality steels for special areas of application. Production costs go way down. Specific smelting capacities rise by up to 30 per cent. Compared with an arc furnace of the same size, the 30-ton plasma furnace distinguishes itself through considerably better working conditions, and it is more friendly to the environment, e.g. the enormous noise pollution disappears.

ND: These facts certainly do make it clear that we're dealing with a top achievement comparable to the development, design and production of the multiple spectrographic camera made by VEB Carl Zeiss in Jena. And here, as there, the most significant reason for this successful push toward scientific and technological excellence is close cooperation with the Soviet Union.

Dr. Müller: Yes, here we have the proof that the joining up of our forces leads to large profits in time and efficiency, to accomplishments which have been attained nowhere else in the world until now. The basis for this was a 1971 agreement signed in the context of the Parity Governmental Commission of the GDR and USSR. In the course of our joint development work we were able to draw upon experience gathered from a 3-ton furnace in our republic, a 5-ton furnce in Chelyabinsk, and then later also from the 10-ton furnace in Freital. The furnace was built and equipped according to joint specifications in a period which represents an international record.

ND: Since we're talking about international comparisons: our two countries are therefore the only ones possessing an operating plasma smelting furnace. Where do other countries stand?

Dr. Müller: Both in Japan and in France an induction furnace with plasma additive heating and a smelting mass of one ton has been developed. In the USA, all development in this area was halted six years ago, largely because of the complete failure of a large technical experiment at the US Steel Corp. The GDR and the USSR are, therefore, now actually the only countries in the world which have a plasma smelting furnace of this size, and what's more, are producing on a three-shift schedule. Naturally, in the non-socialist economic sector there is great interest in our joint results, that is, in licenses.

ND: So can we therefore say that with this new technology and the unit belonging to it we have found a real alternative to the previous primary smelting processes?

Dr. Müller: Yes. Until now, as I already said, the arc furnace was the last word in technology for the production of quality and stainless steels. And that oven can look back on a 75-year history of development. The four-year operation of the 10-ton plasma furnace in Freital and the figures given for the 30-ton furnace prove that the capacities of an arc furnace of the same size are not only matched, but are clearly surpassed. Also, looking at it from the energy side, the question about an alternative can be answered affirmatively. Electricity will be our major source of energy beyond the year 2000, and plasma smelting is already now a process which uses electricity most efficiently, transforms it into the highest temperatures and can be applied for the production of steels of the highest quality.

How The GDR Develops Scientists

Behind the ground-breaking progress in the application of plasma technology for steel production, demonstrated in the GDR's plasma furnace at Freital, lies the conscious policy of the Council of Mutual Economic Assistance countries to promote technological advances and the scientific creativity on which they depend. The official wide-circulation press of the GDR, for example, has been the forum for a public discussion by that country's scientists on the necessary conceptual approach to scientific progress.

In the daily *Neues Deutschland* Jan. 15, Professor Guenter Kroeber contributed a commentary on the personal qualities necessary for scientists: persistence and personal involvement in the task of applying fundamental scientific progress to change technologies. But the scientists "human creative capacity" plays the leading role, stressed Kroeber, "since new knowledge only occurs through creative intellectual achievements." The potential for perfecting the creative capacities of scientists is "practically without limit," he said. "What is required is efforts to constantly expand one's own scientific horizon and to perfect the methodology of scientific work. The potential of scientific creativity grows, if the individual or group makes