The Present Situation of Ferroalloy Production and Consumption in TüRKİYE

Süheyla AYDIN, Onuralp YÜCEL, Cüneyt ARSLAN, Akın KÖKSAL
Istanbul Technical University, Chemistry & Metallurgy Faculty,
Metallurgical & Materials Engineering Department
80626 Maslak, Istanbul - Türkiye

ABSTRACT

Iron and Steel industry has important influences on a country's economics and industrialization processes, whereas in Türkiye this sector is the major consumer of the ferroalloys. There had been a great improvement in Turkish iron and steel industry, especially after the 1980s and as a result, 14.3 million tons of yearly crude steel production placed Türkiye 17th in the world. Increase in steel production caused ferroalloy consumption to escalate. Long products constitute 80% of the steel production in Türkiye whereas standard flat products make the rest. The product composition and the structural characteristics of the production process lead to an increase in ferroalloy consumption, concentrated especially on ferromanganese, ferrosilicon and silicomanganese. As of today, ferroalloy production capacity of Türkiye is 173,800 tons/year; 161500 tons of which is ferrochrome with high and low carbon rates, while the rest is mainly ferrosilicon and ferrosilicochrome (12,300 tons/year). Türkiye is one of leading ferrochrome producers of the world considering the production figures given above. However, this production is mainly exported since Türkiye's stainless steel production level is modest and thus requiring low amounts of ferrochrome. The products of iron and steel industry in Türkiye require vast masses of ferroalloys, which make Türkiye a major importer and exporter of ferroalloys. The scope of this work is to gather production, consumption, import and export values of: ferrochrome, ferromanganese, silicomanganese, ferrosilicon, ferromolybdenum, ferrotungsten, ferrotitanium and ferrovanadium of Türkiye, between 1990 and 2000.

1. INTRODUCTION

Ferroalloy production capacity of Türkiye is 173,800 t/y. Of this capacity 12,300 t/y belongs to ferrosilicon (FeSi) and ferrosilicochrome production (Si-FeCr), while the rest (161,500 t/y) is accounted for the both low- and high-carbon ferrochrome productions (LC-FeCr & HC-FeCr). The basis of this remarkably small ferrochrome consumption is due to the fact that the scale of stainless steel production within the country is very limited. In view of that, FeCr plants are built to exploit the rich chromite ores of Türkiye and to export a value added product instead of simply the ore itself.

World chromite reserves are 7.5 billion tons with roughly 45% Cr_2O_3 content. Turkish chromite reserves, on the other hand, reaches to 30.4 million tons, making 0.4% of the world [1].

Technological background is quite satisfactory in the field of FeCr production in the country. Though technologically on the same level with other FeCr producing countries, domestic production is rather costly due to the expensive energy and financial difficulties. However, Türkiye still has a great competitive potential owing to her immense raw material resources.

A 20% of the steel produced in Türkiye is flat products, while the rest being long. Alloyed and quality steels have a share of 2% in this production. Due to these general characteristics of Turkish steel products, ferroalloys consumed domestically are: imported ferromanganese (FeMn), silicomanganese (SiMn), and ferrosilicon (FeSi), some of which are produced locally.

2. FERROALLOY PRODUCTION IN TÜRKİYE

Eti Holding Ltd., a state-owned company, produces LC- and HC-FeCr, Si-FeCr and FeSi, in Türkiye. Table 1 lists these plants and their capacities. HC-FeCr production is carried out in two open-type arc-resistance furnaces of the old plant, having a total of 50,000 t/y capacity and 17,000 kVA power each.

Table 1. Ferroalloy producing plants and their capacities [2].

Name of the Company	Place & Product type	Capacity (t/y in 1998)
Eti Elektrometalurji Ltd.	Antalya, LC-FeCr	11,500
Eti Elektrometalurji Ltd.	Antalya, FeSi	5,000
Eti Elektrometalurji Ltd.	Antalya, Si-FeCr	7,300
Eti Krom Ltd.	Elazığ, HC-FeCr	150,000

In addition to that, in the new plant, there exist two closed-type arc-resistance furnaces having a total of 100,000 t/y capacity and 30,000 kVA power each [3]. Since the furnaces are closed and the heat that exit gases carry is utilized in pre-heating furnace, about 20% savings in energy consumption is realized in the new plant. LC-FeCr production is conducted in two steps. In the first step, Si-FeCr is produced in an arc-furnace of 7,500 kVA power, containing roughly 45% Si. In the second step, a rich calcium chromite slag is prepared in an arc-furnace of 6,500 kVA power, containing approximately 29-30% Cr_2O_3. This slag, rich in chromium, is mixed with Si-FeCr of the first step in ladles to produce LC-FeCr, via silicothermic reduction process. Si-FeCr is manufactured as a by-product during the production of LC-FeCr. FeSi (75% Si) production is carried out in a 6,000 kVA arc furnace by using quartzite (95% SiO_2), scrap iron (or iron ore) and metallurgical coke.

Approximately 4.4 million tons of FeCr was produced worldwide, in 1998, a 2.5% of which was achieved in Türkiye, ranking our country as the 8th in the world. Ferroalloy production of Türkiye shows increasing trend as the country's ferroalloy capacity and exports increase. Production figures are tabulated in Table 2. HC-FeCr production demonstrated a remarkable increase, especially after 1985.

3. STEEL PRODUCTION AND FERROALLOY CONSUMPTION OF TÜRKİYE

The first integrated iron and steel plant of Türkiye, KARDEMİR, has started its operation in 1939, with a modest capacity of 150,000 t/y. ERDEMİR, the first plant aiming to produce flat products, became operational in 1965, while the third integrated iron and steel plant, İSDEMİR has set out production in 1975. Along with these three state-owned works, 17 private companies, equipped with arc furnaces, emerged especially after 1980s, causing Turkish steel production to prosper; i.e. crude steel capacity of 4.2 million tons in 1980, has increased to 19.9 million tons, in 1999.

In 1980, Türkiye produced 2.5 million tons of steel, supplying 0.35% of the world production (ranking 33rd in the world). In 1999, 14.3 million tons of steel production was realized which placed Türkiye 17th in the world, making 1.87% of the world production of 784.2 million tons [4].

Table 3 shows the distribution of molten steel production in Türkiye, between 1980 and 1999, according to the methods they are produced. As seen, the share of the integrated steel works in the total is decreasing since 1980, while that of plants with electric arc furnaces (EAF) is increasing very rapidly. In 1999, while EAFs were producing 64.1% of the total steel in Türkiye, EAF' share was only 33.4% in the world (Figure 1). Figure 2 displays the amounts of various steel products. As seen, 892,000 tons of flat and 1,643,000 tons of long products were manufactured in 1980, making the share of flats 35% in total. However, this percentage dropped to 20% by 1999, as the products of new plants, built after 1980s, were generally long. The balance between production and consumption could not be secluded and the structure formed was contrary to the world's trend.

Table 2. Ferroalloy production of Türkiye (t/y) [2, 3].

	1985	1990	1995	1996	1997	1998
HC-FeCr	42,000	51,240	80,000	91,700	97,500	100,000
LC-FeCr	11,330	10,600	8,550	9,450	10,820	10,155
Si-FeCr	6,841	6,790	5,690	5,980	7,115	6,530
Fe-Si	5,170	5,225	3,900	4,460	4,730	4,655
Total	65,341	73,855	98,140	111,590	120,165	121,340

Table 3. Türkiye's total crude steel production and its distribution by the processes (×1000 tons) [5, 6]

	1980	1982	1984	1986	1988	1990	1992	1993	1994	1995	1996	1997	1998	1999
BOF	1,312	1,566	2,375	2,929	3,590	3,902	3,493	3,409	3,678	3,622	4,326	4,632	4,496	4,501
EAF	658	1,071	1,464	2,385	3,811	4,947	6,110	7,283	7,679	8,502	8,337	8,919	8,992	9,171
SM	565	540	501	608	582	605	651	722	720	622	719	724	660	637
Total	2,535	3,177	4,340	5,922	7,983	9,454	10,254	11,414	12,077	12,745	13,382	14,275	14,148	14,309

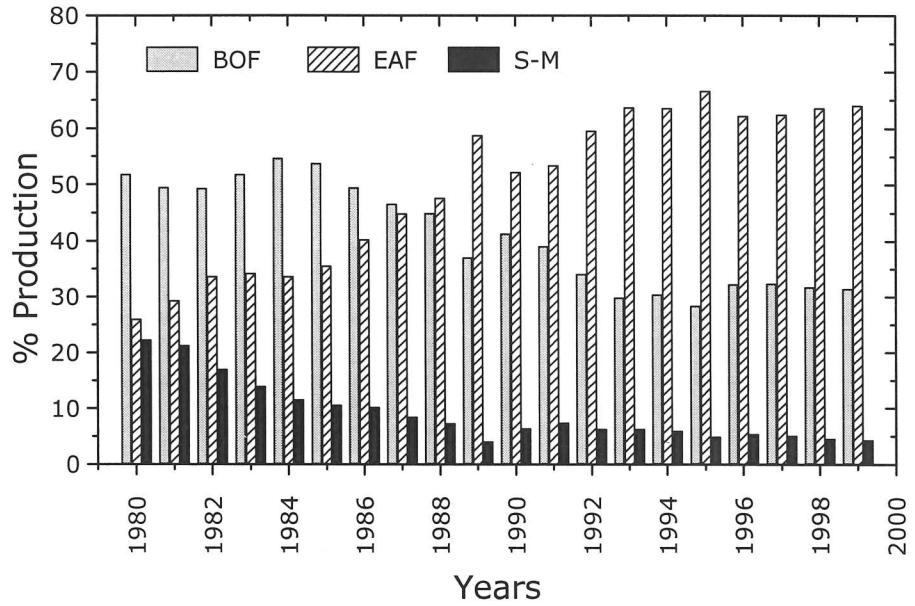

Figure 1. Crude steel production of Türkiye by the process.

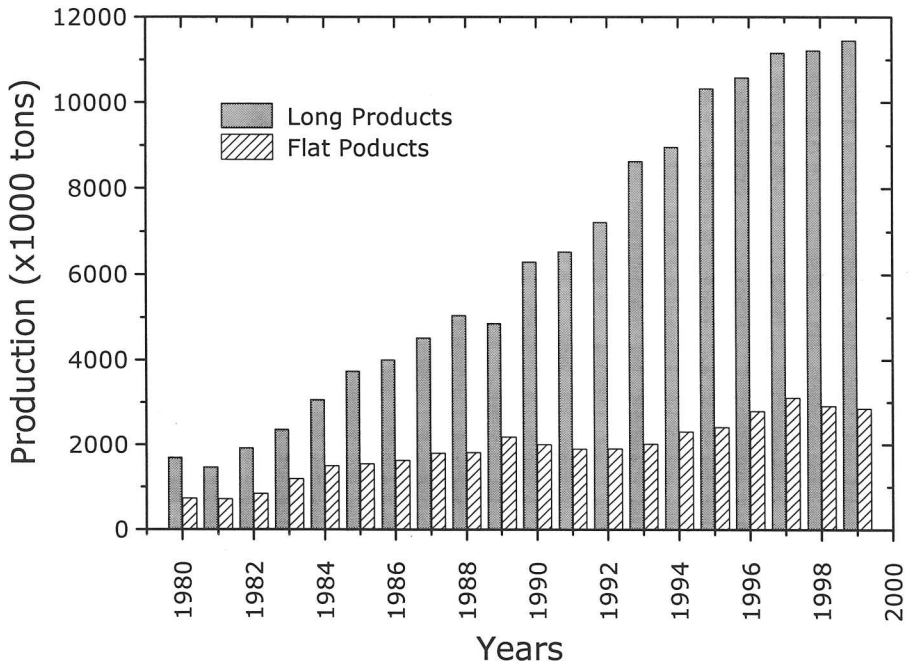

Figure 2. Long and flat steel products manufactured in Türkiye. [5, 6]

In 1999, 20% of the steel produced in Türkiye was flat products, while long products' share was 80%, a 2% of which was special steel. Flat products of Türkiye are tinplate, cold rolled sheet, hot rolled sheet, coated sheet, and strip. Long products, meanwhile, are round bar, reinforced bar, rail, wire, wire rod, profile and special steel.

The most heavily consumed ferroalloys in our country are manganese and silicon based alloys, depending on the production structure of iron and steel sector. Figure 3 displays the ferroalloy consumption and the crude steel production of Türkiye. In 1982, about 3.2 million tons of steel was produced, while ferroalloy consumption was a mere 51,000 tons, a 34.6% of which was ferrosilicon, 62.2% FeMn, and 3.2% both LC- and HC-FeCr. SiMn consumption commenced after 1980 and showed a parallel trend both to the increases observed in domestic steel production by the EAFs and to the general tendency in the world [7]. Its consumption has been doubled within he last decade.

In 1992, steel production has reached over 10 million tons, while ferroalloy consumption realized was over 97,000 tons, a 20.5% of which was FeSi, 31.4% FeMn, and 42% SiMn. In 1995, 171,000 tons of ferroalloy was consumed, whereas 212,000 tons in 1998, a 24% increase in three years, similar to the increase observed in steel production. A 30.2% of this consumption was FeSi, 13% FeMn, and 53% SiMn. Demand for ferroalloys was on the rise over the years, in parallel to the development in steel production. In contrast to the increase observed in FeSi and especially in SiMn consumption, however, the use of FeMn was descending. Domestic FeSi production supplied merely 6.8% of the demand in 1998, and the rest was imported.

4. IMPORTS and EXPORTS of FERROALLOYS

Ferroalloy imports and exports of Türkiye displayed approximately 35% increase since 1990. Almost all FeCr, produced at two state-owned plants are exported, as domestic consumption is very low (Figures 4 and 5). The most important markets for our FeCr products are the U.S.A., EEC countries, and Japan. FeSi production is already inadequate to supply local needs, thus it is not exported.

In 1988, the major HC-FeCr exports were as follows: U.S.A. (38%), Belgium (23%), and Japan (16%). In 1999, however, exports to the United States increased (64.3%), while to Japan decreased (4.5%), and Belgium is replaced by Poland (21.4%) [8].

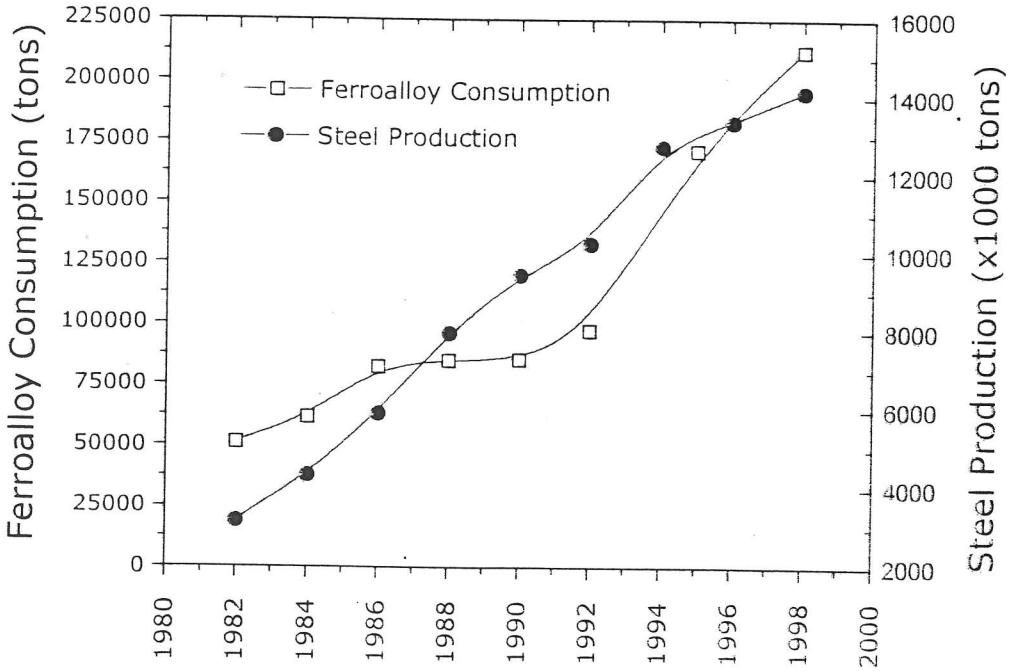

Figure 3. Ferroalloy consumption and the crude steel production of Türkiye [2, 3].

Markets for Turkish LC-FeCr exports are usually the European countries. The largest export in 1988 was made to Holland (56%), followed by Sweden (20.7%), Belgium (20.5%) and Italy (10%). In 1999, on the other hand, Belgium was the major importing country of Turkish LC-FeCr (85%), followed by Sweden (9.5%) and Italy (2.7%).

The yearly changes in imports of the three most heavily consumed ferroalloys in Türkiye are given in Figure 6. This trend is expected to continue provided that the composition of Turkish steel production remains unchanged.

Today, FeSi is imported mainly from Ukraine (46%), Russia (40%), and EEC countries (mostly England (7.3)).

In 1998, the major FeMn imported countries were: Ukraine (41%), South Africa (17%), Norway (13.7%), Brazil (13.2%), and France (11.2%). In 1999, however, South Africa became the first country of FeMn imports with 68%, followed by Norway (16.3%) and France (9.4%).

SiMn imports are made today from Ukraine (72%), Russia (12.4%) and Georgia (7.8%).

These minor ferroalloys, import quantities of which are given in Figure 7 and 8 for the period of 1990 and 2000, are mostly used in casting sector. Ferromolybdenum is imported from China, whereas FeSiMg from Norway and Brazil, FeP from China, FeTi from Russia, FeW from Russia and China.

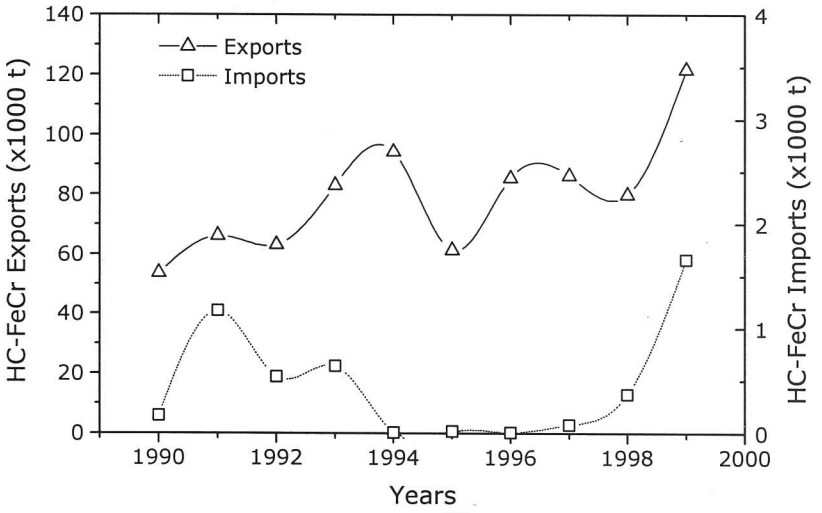

Figure 4. Imports & Exports of HC-FeCr [8].

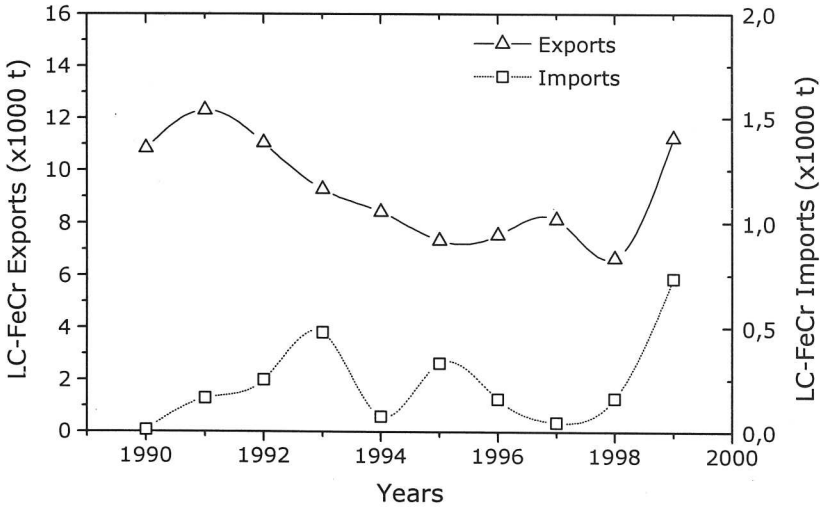

Figure 5. Imports & Exports of LC-FeCr [8].

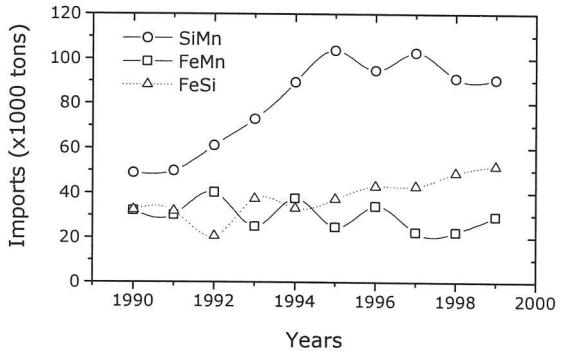

Figure 6. Imports of SiMn, FeMn, and FeSi [8].

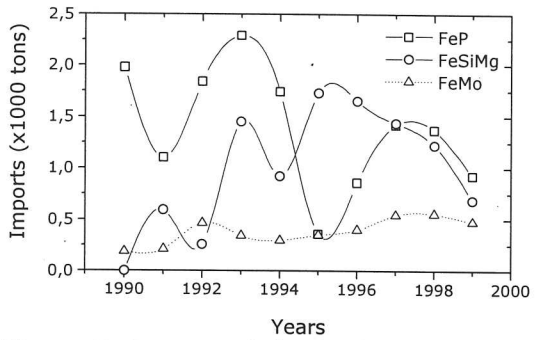

Figure 7. Imports of ferromolibden, ferrosilico-magnesium and ferrophosphorus [8].

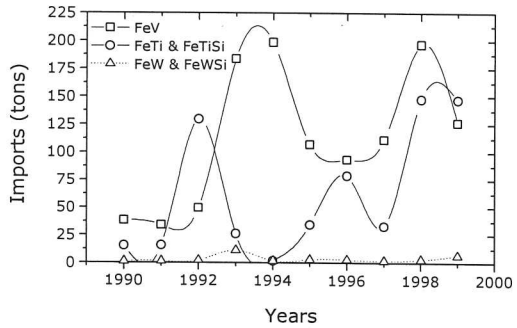

Figure 8. Imports of ferrosilicon-titanium, ferrovanadium and ferrosilicon-tungsten [8].

5. CONCLUSION

Today, Turkish steel production reaches 14.3 million tons/year.e ii tteein steel production caused ferroalloy consumption to escalate. Long products constitute 80% of the steel production in Türkiye, 2% of this share is special steels whereas standard flat products make the rest, 20%. The product composition and the structural characteristics of the production process lead to an increase in ferroalloy consumption, concentrated especially on ferromanganese, ferrosilicon and silicomanganese. This picture of the ferroalloys is not expected to change in the near future of Türkiye.

Although, very competitive in terms of its production and quality in world markets, ferrochrome, produced in Türkiye is totally exported, since the stainless steel and alloyed steel production within the country are very limited.

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