# ROMANIAN FOUNDRY INDUSTRY FEATURES

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The actual Romanian territory (the old Dacia) had been a great attraction for its metal inheritance since old times, being known the fact that the roman army transported big amounts of gold from the conquered Dacia (106 ac).

On the other hand, Romania has an old tradition in the ferrous metallurgy, initiated in the early Hallstatt age. Ferrous metallurgy, practiced even since the 1st millennium bc., was intensely continued in further periods, going through several flourishing stages, the first blast furnaces (conform to the actual concept) having been installed in 1718. By the end of the 19th century over 60 blast furnaces were functioning, in over 40 places, mainly in the western part of the country.

Nowadays, Romania produces over 6.0 mil.t cruel steel annually (with a growing potential of 10.0 mil.t), over 250,000 t Al (with potential growth of 340,000 t by 2007) and over 100,000 t (Cu+Pb+Zn).

Therefore, casting production in Romania is based on a long tradition in metallurgy, in both iron and steel castings production and nonferrous casting production.

Romanian metalcasting production has reached the maximum of 1.5-1.6 mil.t/year during 1987-1989, taking the 9th place in the world casting production in 1989, with over 60 kg/citizen, in conformance with the national industry development programs, specific to the centralized economy at that time.

After December 1989 events and the translation to the open market economy, casting production was lowered to 0.8-1.0 mil.t/year during 1990-1994, to 0.4-0.6 mil.t/year during 1995-1997, eventually leveling off at 400,000 t/year after 1997 (over 17 kg/citizen). *(see Table 1)*

There have been several objective reasons for reducing casting production during the past years, due to the industrial restructuring process, such as:

- The decrease in the requirement of ingot moulds and bottom plates for the steel industry, from over 350,000 t/year down to under 50,000 t/year, due to both the decrease of cruel steel production (from 15-16 mil.t/year to 6 mil.t/year) and the substantial increase of continuous casting techniques usage;
- The dramatical decrease of steel casting production, from values exceeding 350,000 t/year in 1989 (as much as France and Germany cumulated production, 3 times higher than England production and one third of the USA production), down to values of 60,000-70,000 t/year during the last years;
- The decrease of grey cast iron bath tubs and radiators production, field which caused the loss of over 100,000 t/year castings;
- The drop in the requirement of castings from lower grades grey irons, as well as thick wall castings (including tubes).

Consequently, major changes have been registered as concerns the metalcasting production structure, in the past few years *(see Table 1)*.

**METALCASTING PRODUCTION IN ROMANIA** **Table 1**

| METAL CAST | | METRIC TONS & (%) | | | NUMBER OF OPERATING FOUNDRIES | | |
|---|---|---|---|---|---|---|---|
| | | 1989 | 1999 | 2001 | 1989 | 1999 | 2001 |
| **IRON** | Gray Iron | 1030769 (69.2) | 241600 (67) | 255473 (69.9) | | | |
| | Ductile Iron | 38059 (2.6) | 19200 (5.3) | 20736 (5.7) | | | |
| | Malleable Iron | 18594 (1.3) | 6020 (1.7) | 5840 (1.6) | | | |
| | **TOTAL CAST IRONS** | 1087422 (73.1) | 266820 (74) | 282049 (77.2) | 236 | 169 | 176 |
| **STEEL** | **STEEL** | 356110 (23.9) | 65100 (18) | 53798 (14.7) | 87 | 36 | 35 |
| **NONFE-RROUS** | Cooper | | 9600 (2.8) | 9984 (2.7) | | | |
| | Aluminium | | 17100 (4.8) | 18100 (5.0) | | | |
| | Zinc | | 1500 (0.4) | 1560 (0.4) | | | |
| | **TOTAL NONFERROUS** | 45436 (3.0) | 28200 (8.0) | 29644 (8.1) | 181 | 123 | 132 |
| **TOTAL CASTINGS** | | 1488968 (100) | 360120 (100) | 365491 (100) | 504 | 328 | 343 |

One specific characteristic of the Romanian Foundry Industry in 1989, similar to the ones in the other countries with centralized economy (Czech Republic, Poland, Hungary, China, USSR) was the important quota of steel casting production (10-30% in the total), to the detriment of the ductile iron production, with a level of only 2.5-10% *(see Fig.1,2)*.

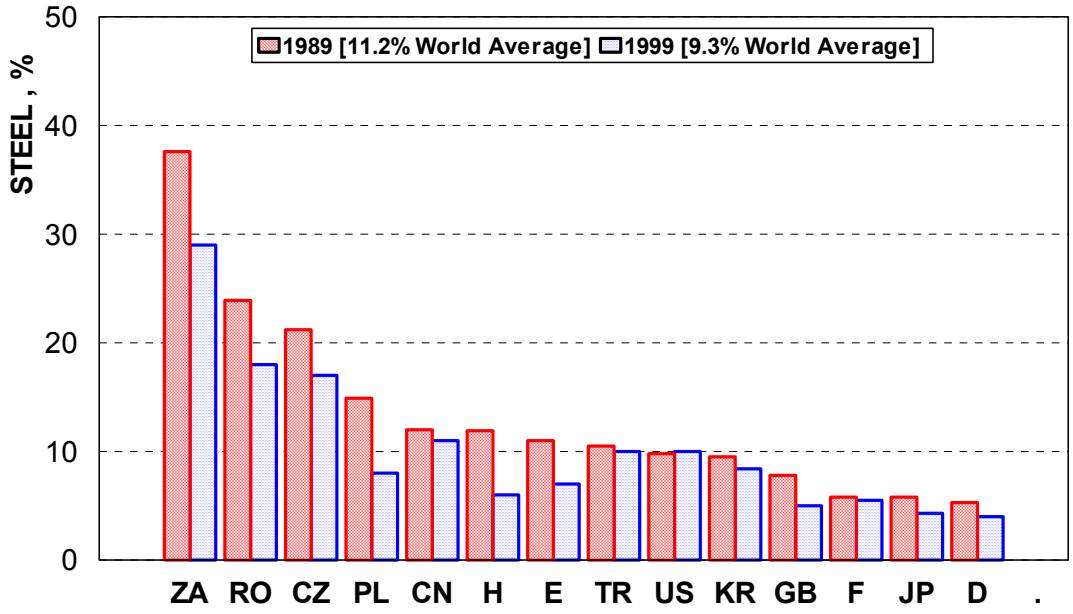


**Fig.1 STEEL RATE IN THE TOTAL CASTINGS PRODUCTION**

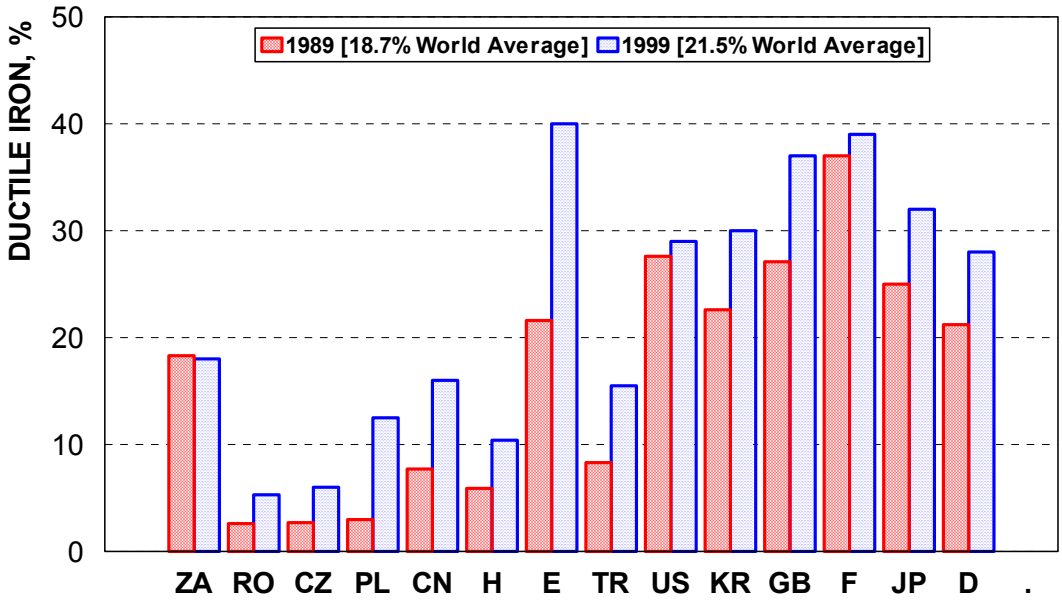


**Fig. 2 DUCTILE IRON RATE IN THE TOTAL CASTINGS PRODUCTION**

In a totally opposite position was placed the casting production in the developed countries with open market economy, such as USA, England, France, Japan, Germany, where Steel casting production registered a 5-10% quota and Ductile Iron production registered a 20-37% quota.

In this context, Romania occupied the most critical position, with the highest steel castings quota (over 24%, the second place in the world after South Africa) and the lowest ductile iron quota (2.6%), despite the fact that Romania has been producing this material since 1949 ( ELECTRON alloy - 90 %Mg / 10% Al - as nodulizer, american war plaines scrap ) .

10 years later, the position of both groups of countries was basically the same, with the only remark that the first group also registered some positive mutations, towards the decrease of steel castings quota by about 25% in Romania, 20% in the Czech Republic, 50% in Poland and Hungary, and no major changes in China. Concomitantly, the Ductile Iron quota has grown about 2 times in Romania, Czech Republic, China and Hungary, and 4 times in Poland, respectively.

As regards Romania, it is expected the growth of the total metalcasting production to over 600,000 t/year in the next years, as well as the increase of the Ductile Iron quota to over 25% of the total, due to the development of some major industrial programs able to stimulate the high quality metalcasting production, to cope with the worldwide requirements, such as:

- **The Automotive Industry**, by the Renault (Pitesti) and Daewoo (Craiova) programs, both automotive producers having become the owners of the Romanian enterprises in the field, and both aiming to produce about 200,000 automobiles/year, with the major contribution of some other Romanian plants;
- **Pressure Ductile Iron Pipes**, products newly launched in Romania, in two foundries (Calan and Orastie), each with a total production capacity of 40,000 t/year pipes in the field of D=100…700mm, being in the start of production stage. One of the foundries is already privatized, while the other is in the course of privatization;
- **Oil equipment**, Romania having a long tradition in the field, enterprises in this domain such as the ones in Ploiesti and Campina having been privatized to worldwide known foreign companies;

- **Machine tools** for all destinations are currently produced only in privatized companies, by Italian, French and USA producers;
- **Ductile Iron Heavy Castings**, mainly for export destinations, at a level expected to exceed the current total production of such material.

Romanian metalcasting production covers today a wide range of fields of utilization, with destinations varying largely for both the internal market and the export markets *(see Table 2)*. It can be noticed that higher quotas are covered by the machine construction industry, vehicle, tractor and agricultural machinery industries, oil and mining industries, electric and nuclear power industry, metallurgical and chemical industries, machine tools, etc.

A major focus is posed on the increase of Ductile Iron production, a large number of foundries disposing of appropriate technologies. There are used on a large scale techniques such as Tundish Cover and Sandwich, as well as highly effective treatment alloys (nodulizers and inoculants) from prestigious foreign producers (e.g. ELKEM Norway) or internal producers (FERRALT Campina, MECANICA Vaslui). Some major contribution to the Ductile Iron production stimulation will be brought by the new desulphurizer, recently produced in the $CaC_2$/CaO-C system (CARBID FOX Tarnaveni), successfully used in the Romanian foundries, both in acid lining coreless induction furnaces (50Hz) and in specific equipment (mechanical stirring and porous plug).

Specific to the Ductile Iron production in Romania is the large scale utilization of the high purity synthetic pig iron, obtained from steel scrap in several Romanian foundries. For all that, it is increased the utilization of special pig iron type SORELMETAL, specific to the production of high quality ductile irons.

It is also continually increasing the implementation of solidification simulation programs, such as MAGMASOFT, NOVACAST, SIMULOR.

One major problem of the Romanian Foundry Industry consisted in the existence of high production capacity foundries. Thus, in 1980 the total production capacity of 2.0 mil.t/year was provided by 317 foundries, but 70% of the whole capacity was covered by only 20% of the foundries.

These big foundries were the first to be affected by the industrial restructuring process started after 1989, this having substantially contributed to the dramatic decrease of the metalcasting production. The drop in their production turned many of these foundries ineffective, leading to their disappearing or radical transformation, starting with their dividing in several profit centers and continuing with the privatization process.

The most affected were the steel foundries, their number dropping by 50-60%, while the cast iron and nonferrous foundries were affected in about 25% cases.

In addition, there have been installed over 50 new foundries with lower production capacity, 100% private capital, effective and able to produce high quality castings, for both the internal and external markets.

In 2001, iron castings were produced in 176 foundries, steel castings in 35 foundries, while nonferrous castings (based on Cu, Al, Zn) were produced in 132 foundries, some of the foundries producing several types of metallic materials. As regards cast irons, most of the foundries produce grey iron castings, over 50 produce ductile irons, but only 9 produce malleable irons.

**Table 2**

**THE RANGE OF USE OF CASTINGS PRODUCED BY ROMANIAN REPRESENTATIVE PLANTS**

| No. | USE OF CASTINGS | OPERATING FOUNDRIES | |
|---|---|---|---|
| | | Plants Number | Rate, % |
| 1. | Oil industry | 12 | 7.8 |
| 2. | Mining industry | 27 | 17.5 |
| 3. | Electric and nuclear power industry | 24 | 15.6 |
| 4. | Chemical and petrochemical industry | 20 | 13.0 |
| 5. | Metallurgical industry | 25 | 16.2 |
| 6. | Building equipment and building materials industry | 19 | 12.3 |
| 7. | Ship building industry: shipyards | 7 | 4.5 |
| 8. | Vehicle industry | 34 | 22.1 |
| 9. | Tractor and agricultural machinery industry | 30 | 19.5 |
| 10. | Electrotehnical industry | 11 | 7.1 |
| 11. | Fine mechanics and aircraft industries | 5 | 3.2 |
| 12. | Railway waggon and locomotive production | 13 | 8.4 |
| 13. | Machine-tools and heavy machine industries | 20 | 13.0 |
| 14. | Wood working machines and rubber industries | 6 | 3.9 |
| 15. | Milling and Food industry; Home electric appliances industry | 11 | 7.1 |
| 16. | Textile and light industries | 21 | 13.6 |
| 17. | Pump and fitting manufactures | 21 | 13.6 |
| 18. | Sewerage and sanitary parts; irrigations | 22 | 14.3 |
| 19. | Hydraulic equipment manufactures | 7 | 4.5 |
| 20. | Machine construction industry | 69 | 44.8 |

Obs. 1) N=154 Representative Plants, which may include more foundry shops.
2) Some foundries produce castings for more use fields.

With concern to the **Melting Shops**, the Romanian foundries are equipped with all specific features in the industry *(see Table 3, Fig.3)*, being worth mentioning the following:

- **Coreless induction furnaces** are mostly used, being present in ¾ of the Romanian foundries, mainly cast irons but also nonferrous alloys and steel foundries. There are used medium frequency furnaces (0.1-2.0t), as well as lower frequency furnaces (3.5-20.0t), being obvious the active tendency to transform the old ones, of low and medium frequency, into the new generation of medium frequency furnaces (200-1000Hz, over 300 KW/t as specific power), of higher productivity. The number of modern furnaces has grown in the past few years, new or obtained by transformation, provided by specialized Romanian companies (INDUCTRO Bucuresti, AAGES Tg.Mures) and also by foreign companies (CALAMARI, INDUCTHOTERM, ABB, JUNKER).

**MELTING FACILITIES IN THE REPRESENTATIVE PLANTS** **Table 3**

| No. | MELTING AND HOLDING FACILITIES | OPERATING FOUNDRIES | |
|---|---|---|---|
| | | Plants number | Rate, % |
| 1. | Cupola furnaces | 67 | 43.5 |
| 2. | Induction crucible furnaces | 117 | 76.0 |
| 3. | Induction holding furnaces (channel-type) | 19 | 12.3 |
| 4. | Arc furnaces | 55 | 35.7 |
| 5. | Flame furnaces (crucible and rotary types) | 68 | 44.2 |
| 6. | Electric resistance furnaces | 7 | 4.5 |

Obs. 1) N=154 Representative Plants, which may include more foundry shops.
2) Some foundries use more furnace types.

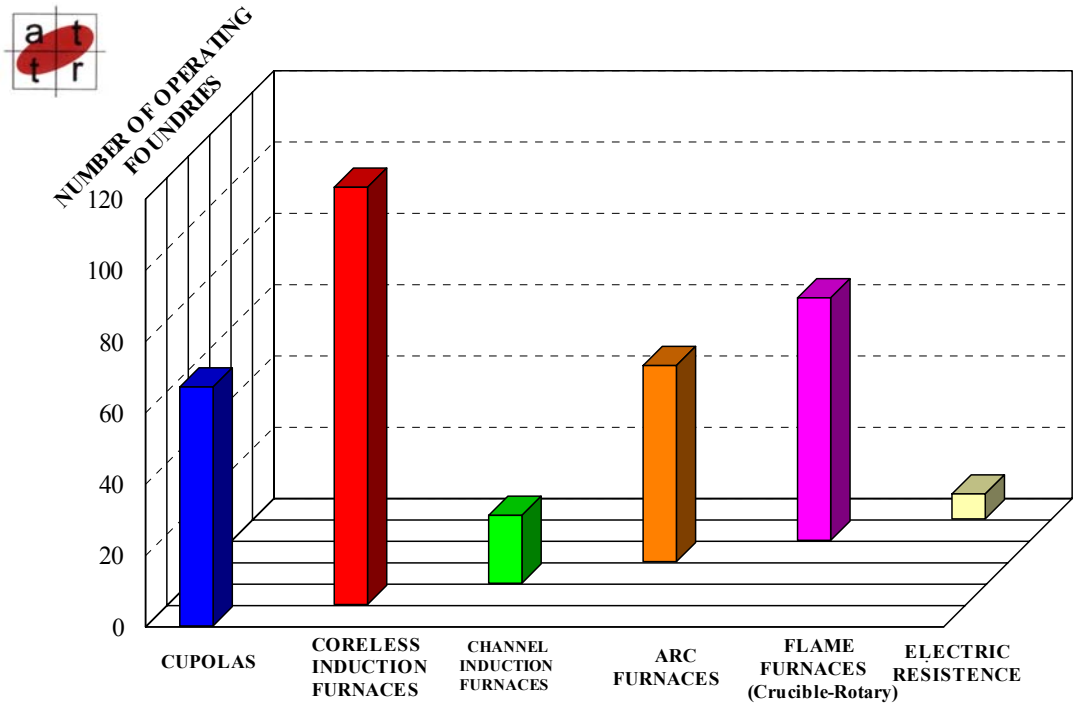


**Fig. 3 MELTING FACILITIES IN THE ROMANIAN FOUNDRIES**

- **Cupolas** are present in nearly half of the cast irons foundries (mainly grey iron foundries), of lower capacity (D=500-1700 mm, over 90% at max. 800 mm). One specific characteristic consists in the utilization of cold divided blast air cupolas on a large scale, many of them in optimized regime, for ensuring higher utilization of lower quality coke.

Consequently to the decrease of the production capacity usage, cast iron foundries would rather use induction furnaces instead of cupolas, the later registering lower usage lately. It is also highly used the cupola-induction furnace duplex system.

- **Electric arc furnaces** are present in all steel foundries, being used only seldom in cast irons production, mainly Ductile Iron or high purity synthetic Pig Irons, destined for Ductile Iron production.

- **Flame furnaces** are practically used only in nonferrous alloys foundries.

Refractory materials for melting shops are more and more at higher quality standard , especially for induction furnaces , from domestic or foreign market ( such as Lafarge ) .

As regards **Moulding and Coremaking Shops** *(see Table 4, Fig.4)*, over half of the Romanian foundries dispose of machine moulding, being increasingly used furan/phenol resin processes (domestic or imported resin, such as Huttenes Albertus and Murexim Furtenbach).

**MOULDING AND CORE MAKING PROCESSES** **Table 4**

| No. | PROCESSES | OPERATING FOUNDRIES | |
|---|---|---|---|
| | | Plants Number | Rate, % |
| 1. | CLAY AND OIL-SAND PROCESSES | | |
| | -Machine moulding | 89 | 57.8 |
| | -Hand moulding | 127 | 82.5 |
| 2. | FURAN/PHENOL RESIN PROCESSES | | |
| | -Moulds | 20 | 13.0 |
| | -Cores | 39 | 25.3 |
| 3. | CRONING / HOT BOX PROCESSES | | |
| | -Shell moulds | 18 | 11.7 |
| | -Cores | 58 | 37.7 |
| 4. | CORE MAKING | | |
| | -Water-Glass | 44 | 28.6 |
| | -COLD-BOX (No-Bake) | 14 | 9.1 |

Obs. 1) N=154 Representative Plants, which may include more foundry shops.
2) Many foundries use several different processes.

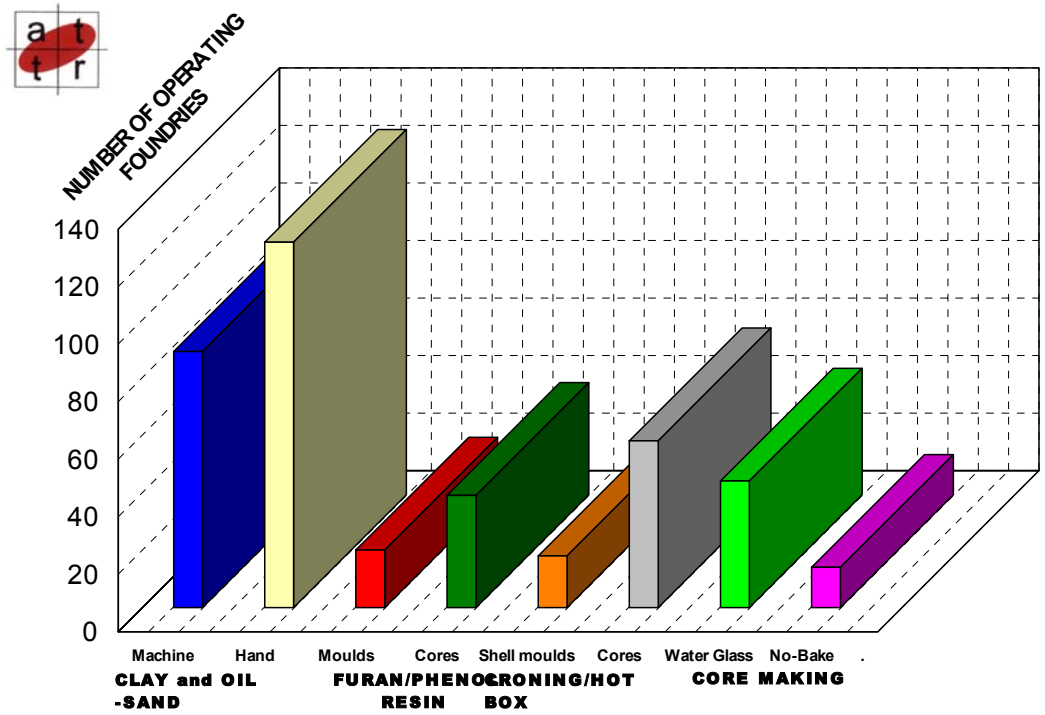


**Fig. 4 MOULDING AND CORE MAKING PROCESS IN ROMANIAN FOUNDRIES**

It is worth pointing out the increase of import of high performance equipment for preparing, moulding and coremaking, reclamation, shotblasting etc., from companies such as EIRICH Germany, HWS Germany, IMF Italy, COGEIM Italy, OMEGA England, etc.

High utilization proves also the special pouring techniques, such as Investment Casting, Gravitational and Pressure DieCastings or Centrifugal Casting *(see Table 5, Fig.5)*.

**SPECIAL POURING TECHNIQUES IN THE REPRESENTATIVE FOUNDRIES Table 5**

| No. | CASTING PRODUCTION TECHNIQUES | OPERATING FOUNDRIES | |
|---|---|---|---|
| | | Plants number | Rate, % |
| 1. | V-Process | 3 | 1.9 |
| 2. | Investment Casting | 16 | 10.4 |
| 3. | Gravitational Die Casting | 28 | 18.2 |
| 4. | Pressure Die Casting | 30 | 19.5 |
| 5. | Centrifugal Casting | 21 | 13.6 |
| 6. | Continous Casting | 4 | 2.6 |

Obs. 1) N=154 Representative Plants, which may include more foundry shops.
2) Some foundries use more techniques.

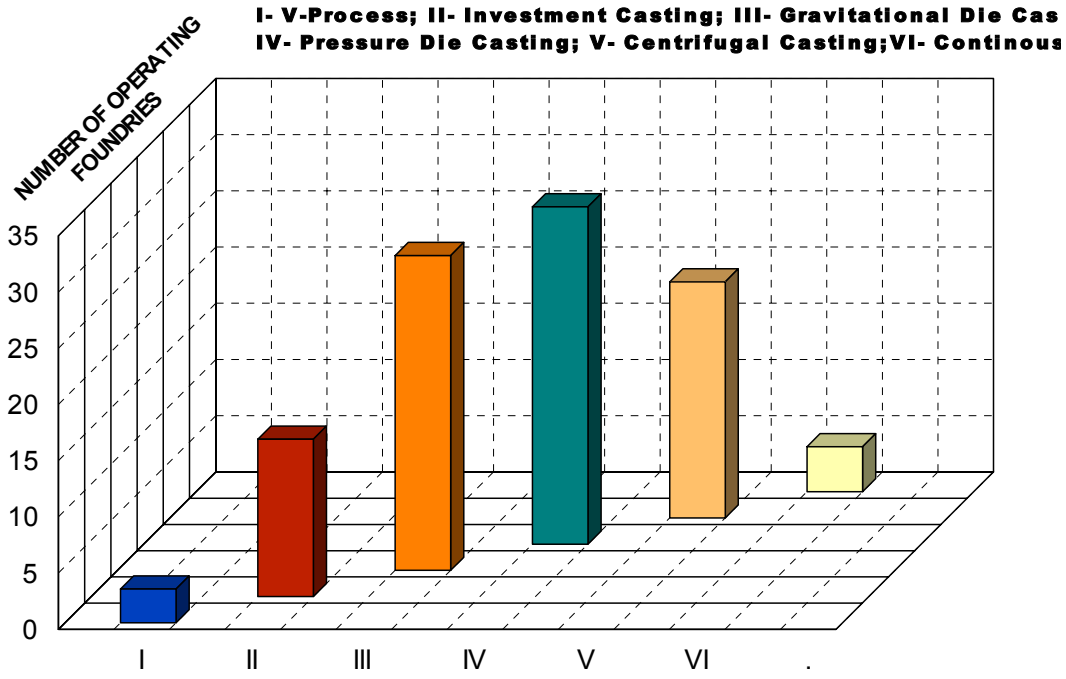


**Fig.5 SPECIAL CASTING TECHNIQUES IN ROMANIAN FOUNDRIES**

## CONCLUSIONS:

- Romanian Foundry Industry has undergone a deep restructuring process in the past few years, due to the transition from the centralized economy to the open market economy, and also to the change in the form of ownership, these having resulted in the decrease of the metalcasting production by over three times.

- The production become stable at the level of 400,000 t/year, with a potential growth of over 50% in the next few years (there are some production capacities for this purpose), due to the development of some major industrial programs, such as: the automotive industry completely restructured (taken over by Renault and Daewoo), the newly introduced pressure ductile iron pipes production (in course of privatization by companies specialized in the field), valves and fittings (especially ductile iron), oil equipment (long tradition), machine tools – all these fields being privatized to the highest extent.

- The steel casting production dropped dramatically, production capacities being available in this field, which could take additional orders of over 100,000 t/year with no major implications.

- The iron casting production has been restructured and directed towards the production of higher strength grey irons (Rm > 200 MPa) and mainly ductile iron, the later preponderantly for the automotive castings industry, valves, machine construction industry and ductile iron heavy castings. There has also been maintained an important base for malleable iron production, one foundry in this field being completely modernized.

- The nonferrous alloys are represented in the Romanian Foundry Industry by the Al, Cu and Zn-base alloys, the production of Al-base castings registering continual growth, especially in the diecasting field.

- At present, most of the Romanian foundries have private ownership, many of them having been re-capitalized and technologically upgraded, respectively reoriented towards the production of castings which are requested on the market.

- The offer is highly complex, Romanian foundries being able to produce castings for most of the industrial fields, such as: machine building industry, vehicle industry, tractor and agricultural machinery industry, oil and mining industries, metallurgical industry (including irons and steel rolls), electric and nuclear power industry, chemical and petrochemical industry, electrotechnical, fine mechanics and aircraft industries, railway wagon and locomotive production, machine-tools, wood working machines, pump and fitting manufactures, sewerage and sanitary parts, hydraulic equipment, textile and light industries etc.

- As regards the Melting Shops, Romanian foundries preponderantly use electric furnaces, coreless induction furnaces for iron and nonferrous foundries, and electric arc furnaces for steel foundries. It is in continual extension the use of new generation medium frequency induction furnaces (200-1000 Hz, with higher specific power).

- There are used both hand moulding and machine moulding lines with green and dry sand, on resin base (increasingly used) or sodium silicate. More and more foundries implement high performance imported equipment in the moulding and coremaking shops.

- There are also increasingly used modern quality control techniques for castings, including nondestructive control and solidification simulation.

Romanian Foundry Technical Association (ATTR) is deeply involved in supporting competitive metalcasting production, yearly organizing conferences, symposiums or technical seminaries, on topical interest themes or presentations sustained by those companies (foreign or Romanian) interested in promoting their range of products and services.

By editing the quarterly ROMANIAN FOUNDRY JOURNAL, ATTR offers the possibility to present technical, economical and commercial information (including advertising materials), offers and requirements to the Romanian Foundry Industry.

By the recently launched website **www.foundry-attr.ro**, ATTR maintains a permanent contact with the Romanian foundries, providing them with valuable information on major

events in the field, national and international, recent products offers or calls for castings production from Romanian and foreign companies, major technical achievements or commercial information, etc. English language information are available on the most of ATTR activities and opportunities for foreign partners.

ATTR will organize the National Conference and Exhibition in September 2003, both benefiting from international participation.