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Structure of Foundry Production in the World and in Poland over the 1974-2013 Period

M.S. Soiński *, K. Skurka, A. Jakubus, P. Kordas
[a] Department of Foundry, Częstochowa University of Technology, Dąbrowskiego 69, 42-201 Częstochowa, Polska
*Corresponding author. E-mail address: soinski.ms@wip.pcz.pl

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Abstract

The paper presents data illustrating the total production of castings in the world and in Poland over the 1974-2013 period. The fractions of basic casting alloys in the total amount of material used for the production of metal castings during the considered period of time were found. It was noticed that the fraction of grey cast iron castings in the total amount of the produced castings decreased significantly over the past 40 years, both on a global scale (from about 65-75% to about 45%) and in Poland (from about 75-80% to about 45-55%). The fraction of SG iron increased considerably, up to about 25% in the world, and up to about 12-16% in Poland. The fraction of malleable became almost negligible (about 1%). The fraction of cast steel took different course in Poland and in the world: it stabilised on a global scale at about 10% in recent years, but dropped down to the level of about 4-7% in Poland. The use of aluminium alloys for the production of casting grew dynamically; their fraction in the total production of casting rose from somewhat less than 4% to almost 15% on a global scale. As far as Poland is considered, this growth was ever more intensive: from about 6-8% to about 25-30% in the 1989-2013 period (the detailed data for the previous period of time are lacking).

Keywords: Foundry production, Cast iron, Cast steel, Aluminium alloys, Non-ferrous alloys

1. Introduction

A comparison of the fractions of individual casting alloys in the total amount of material used for the production of metal castings, both on a global scale and in Poland, allows to make some significant assessments. First of all, it is possible to find if the tendencies characterising the production of castings in our country were or are still convergent with the global trends.

Authors' previous work [Ref. 1] presents the data describing the production of castings in selected countries, including Poland, in the 1999-2013 period. During the mentioned period of time the production of castings in the world increased from about 65 million tons to over 103 million tons, and in Poland from about 700 thousand tons to almost 1300 thousand tons. A significant increase in casting production was observed in China and India, as well as – though to the less degree – in Brazil. The first of the mentioned countries took a leading position in the world foundry industry in 2001, and still holds the position with over 40% share in the global foundry production.

It seemed significant to determine if the characteristic tendencies in foundry industry of the 1999-2013 period can be valid over the preceding years, and to the what extent they can be considered as such, taking into account the quarter-century prior to the year 1999. The assessment with regard to the prevalence of casting alloys, of which ones grew in significance and others became less and less important over the past 40 years, seems to be worth considering.

2. Production of castings in the world and in Poland from 1974 to 2013

The production volume of castings on a global scale changed within a fairly broad range over the past 40 years, i.e. over the

1974-2013 period (the latest data are still not available in statistic reports): from the minimum of about 33 million tons reported in 1983 [2] to about, or even more than, 80 million tons over the years 1978-1980 [3-5] and 2004-2013 [6-15].

According to F. Stręk who cited the data with respect to the production of castings in Poland in the years 1936-1986 [16], the greatest production volume of castings in Poland was reported in 1997, and it was equal to 2653.2 thousand tons. This level has never been reached again, even in the recent years.

The data concerning the total production volume of castings on a global scale and in Poland over the 1973-2013 period are presented in Figures 1 and 2, respectively. The diagrams have been prepared on the basis of data taken from References [2-42]

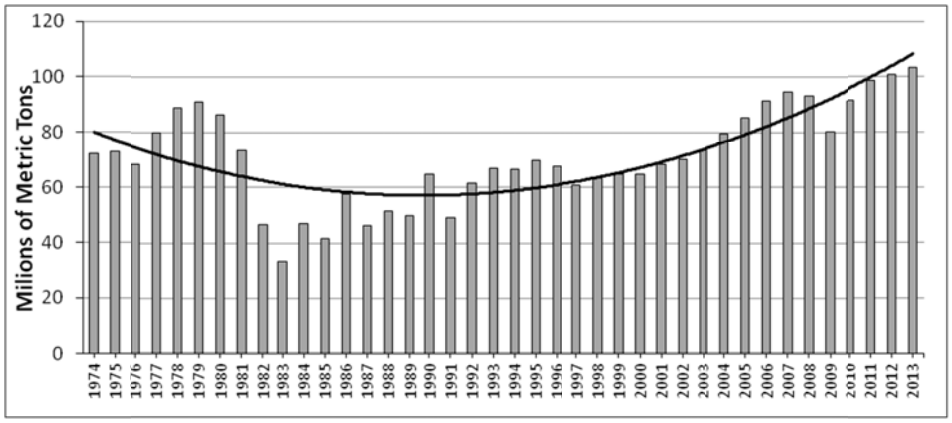

Fig. 1. The global production of castings over the 1974-2013 period [2-15, 17-42]

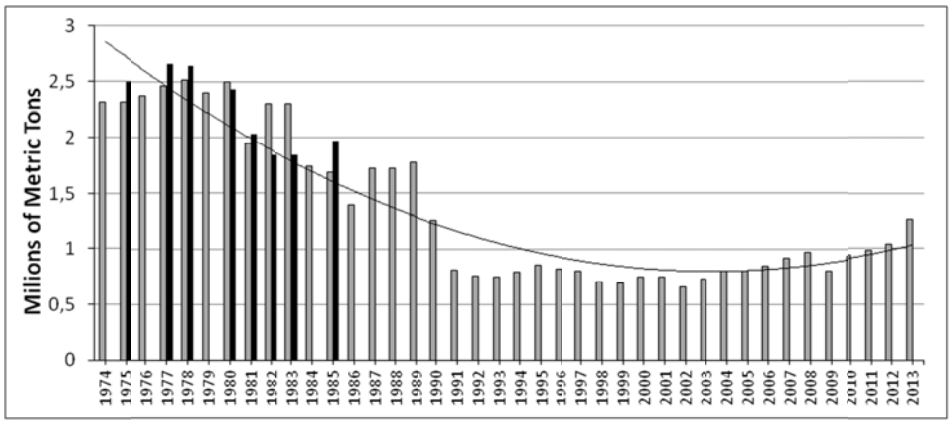

Fig. 2. The total production of castings in Poland over the 1974-2013 period; the bright columns illustrate the data coming from References [2-15, 17-42], the dark columns show the data from the Reference [16]

Figure 2 presents the data concerning the production volume of castings in Poland, and for the years 1975, 1977, 1978, 1980-1983, and 1985 it compares the data coming from different sources. The data cited by F. Stręk [16] are higher for five cases, and lower for three cases, from the data occurring in the relevant listings in 'Modern Casting'. The reason of this differences is now hard to explain.

Figures 3-14 illustrate changes in fractions of the total amount of the production volume of castings with respect to such alloys as grey cast iron, SG iron, malleable, cast steel, aluminium alloys, and the rest of the non-ferrous alloys. The odd-numbered figures refer to the global production, and here the appropriate values were determined for all the considered period (1974-2013). The even-numbered figures present the results of calculation with regard to the production of castings in Poland. It should be mentioned here that the pertinent listings published by 'Modern Casting' neither distinguish between various types of cast iron produced in Poland nor provide any data about our domestic production of non-ferrous castings for about fifteen initial years of the considered period. The indicated production of grey cast iron includes, in fact, not only the cast iron with flake graphite, but also the one with nodular graphite, and the malleable. The lacking data were to some extent replaced by the data cited in Reference [16] by F. Stręk. This author, however, distinguished only between the grey cast iron and malleable, and the SG iron production is probably included in the production of grey cast iron.

Moreover, due to the lack of some data about the production of castings in Poland in 2008 and 2009 (omitted in statistic listings published by 'Modern Casting'), the data coming from Reference [43] were used to complete the work.

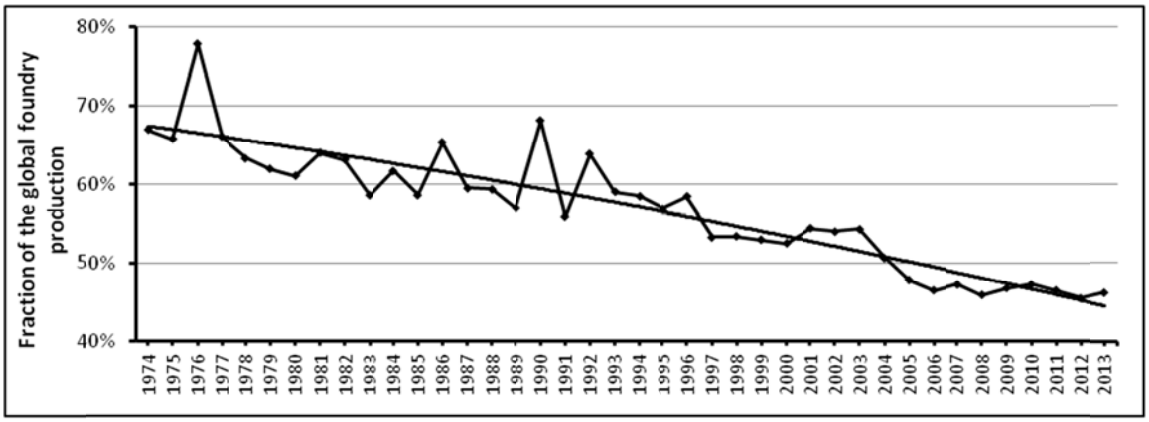

Fig. 3. The fraction of grey cast iron in the global production of castings over the years 1974-2013 [2-15, 17-42]

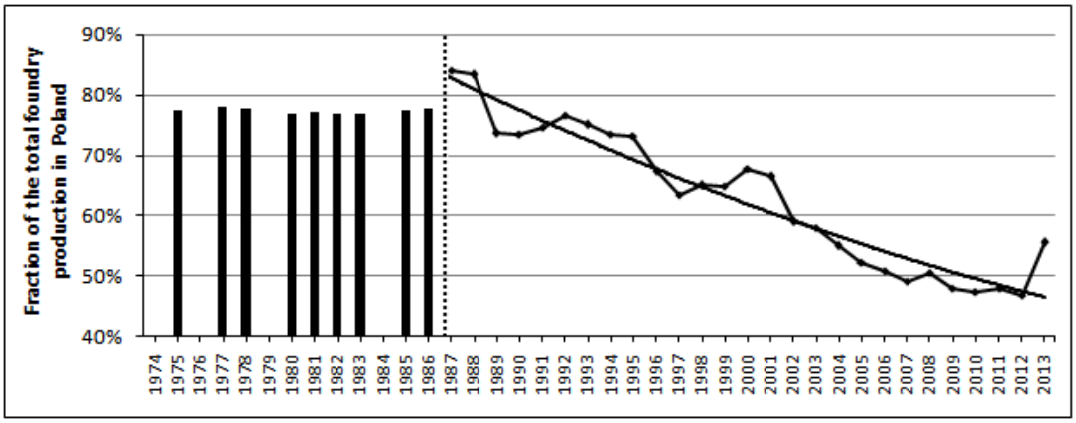

Fig. 4. The fraction of grey cast iron in the total production of castings in Poland over the years 1975-2013; the analysed factor was calculated according to the data from Reference [16] for the period 1975-1986, and according to the data from References [2-15, 17-42] for the following years, except for the years 2008-2009, for which the data were taken from Reference [43]

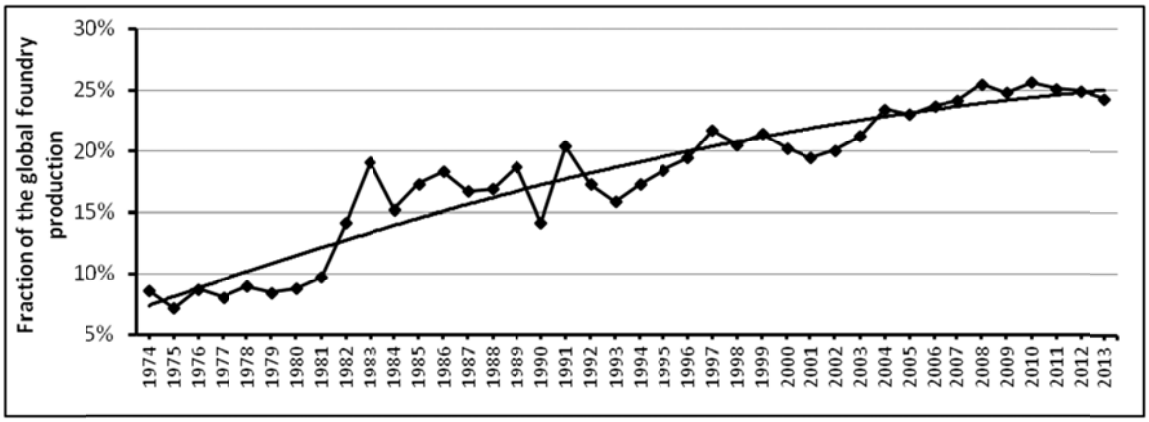

Fig. 5. The fraction of SG iron in the global production of castings over the years 1974-2013 [2-15, 17-42]

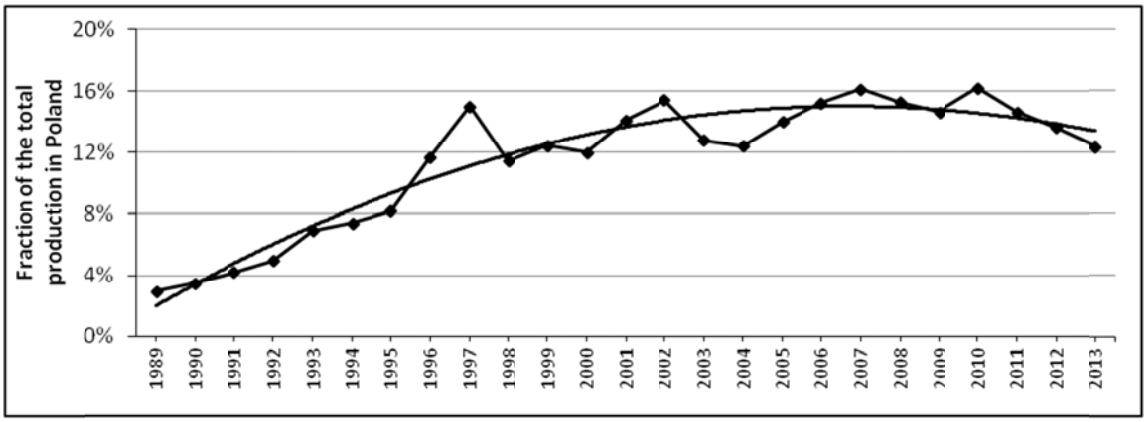

Fig. 6. The fraction of SG iron in the total production of castings in Poland over the years 1989-2013 [6-15, 28-42]; the data for the years 2008-2009 were taken from Reference [43]

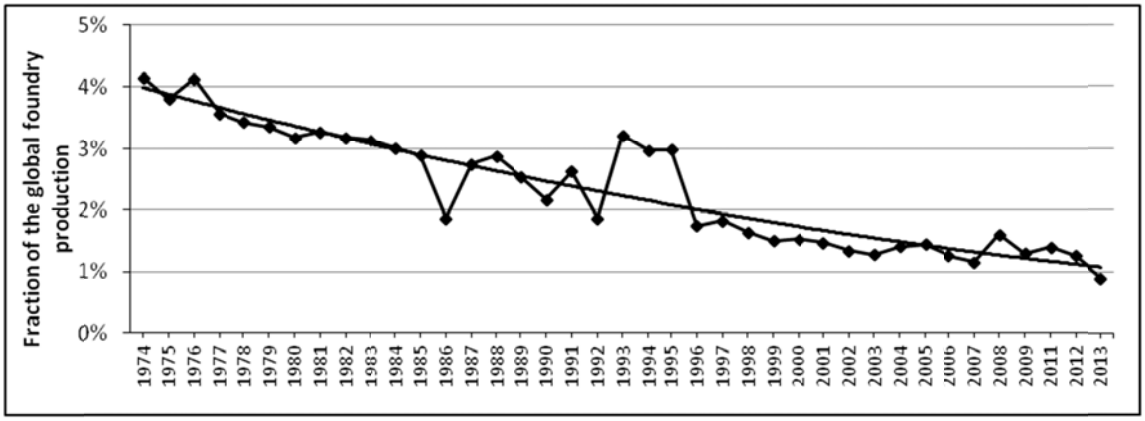

Fig. 7. The fraction of malleable in the global production of castings over the years 1974-2013 [2-15, 17-42]; the year 2010 is omitted (data are lacking)

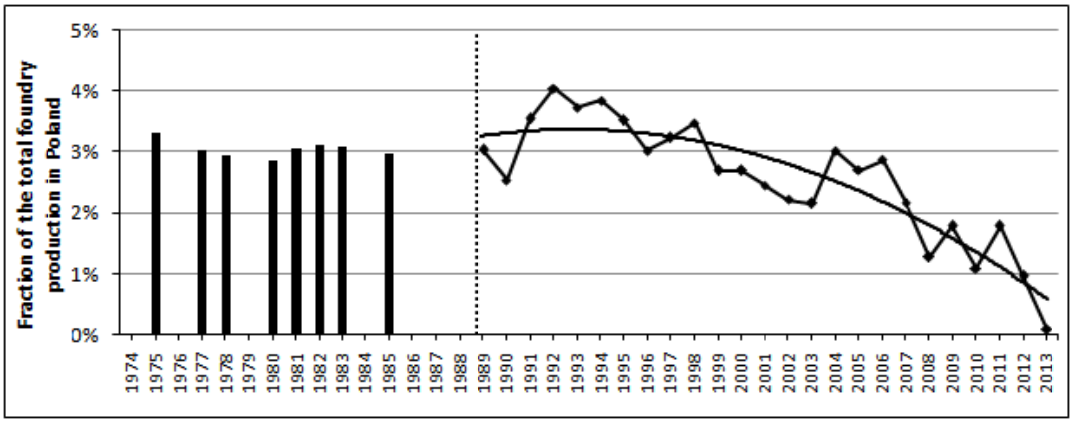

Fig. 8. The fraction of malleable in the total production of castings in Poland over the years 1975-2013; the analysed factor was calculated according to the data from Reference [16] for the period 1975-1986, and according to the data from References [2-15, 17-42] for the following years, except for the years 2008-2009, for which the data were taken from Reference [43]

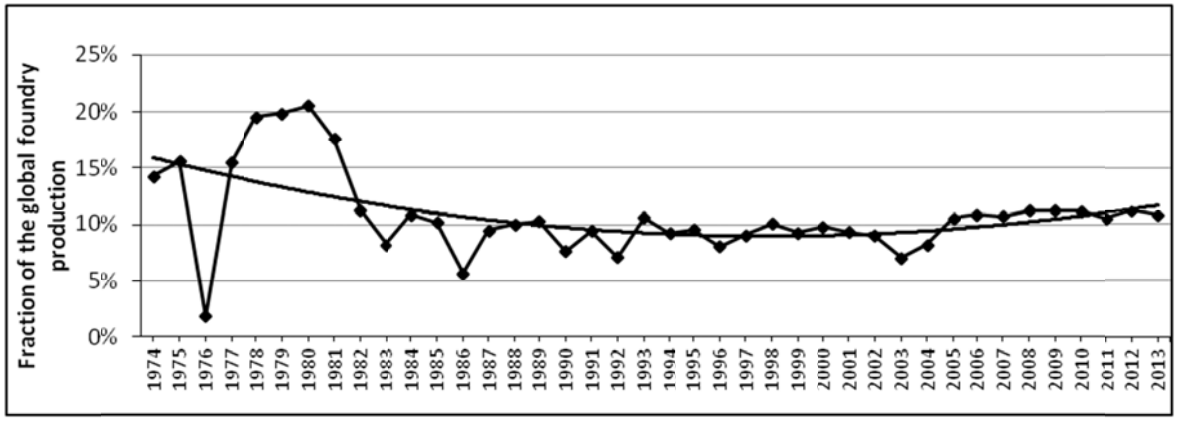

Fig. 9. The fraction of cast steel in the global production of castings over the years 1974-2013 [2-15, 17-42]

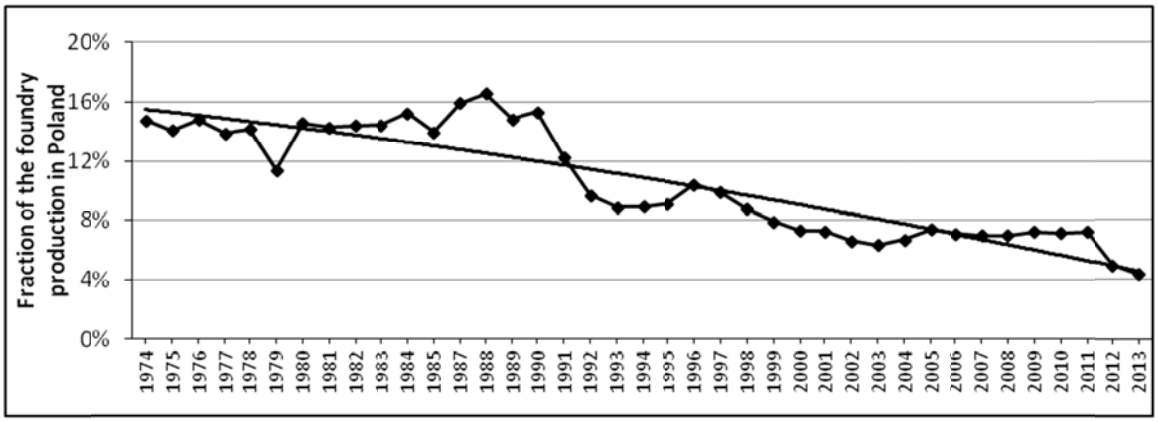

Fig. 10. The fraction of cast steel in the total production of castings in Poland over the years 1974-2013 [2-15, 17-42]; the data for the years 2008-2009 were taken from Reference [43], and the year 1986 is omitted (data are lacking)

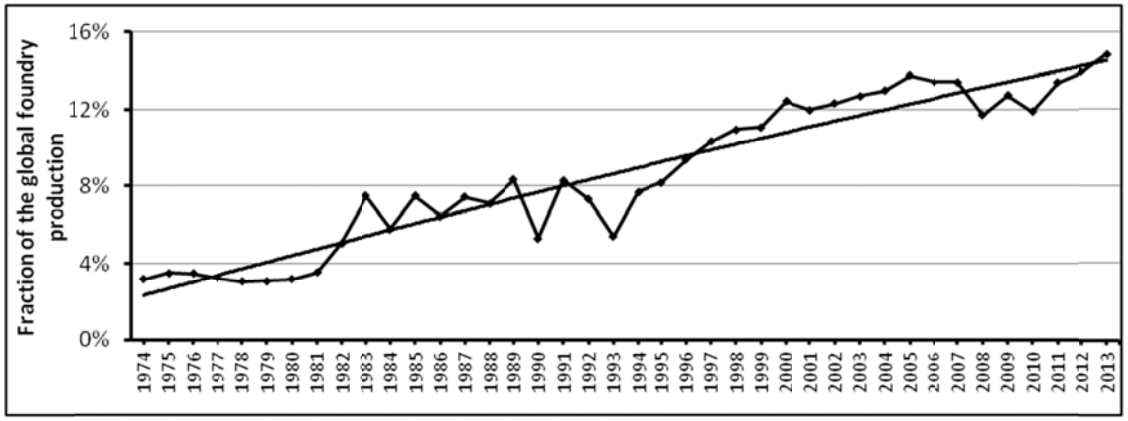

Fig. 11. The fraction of aluminium alloys in the global production of castings over the years 1974-2013 [2-15, 17-42]

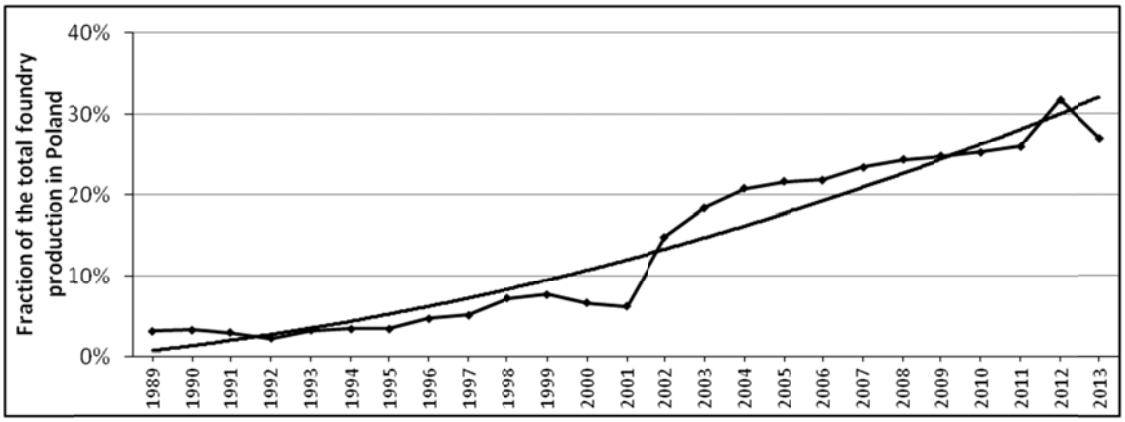

Fig. 12. The fraction of aluminium alloys in the total production of castings in Poland over the years 1989-2013 [2-15, 17-42]; the data from the previous years are lacking

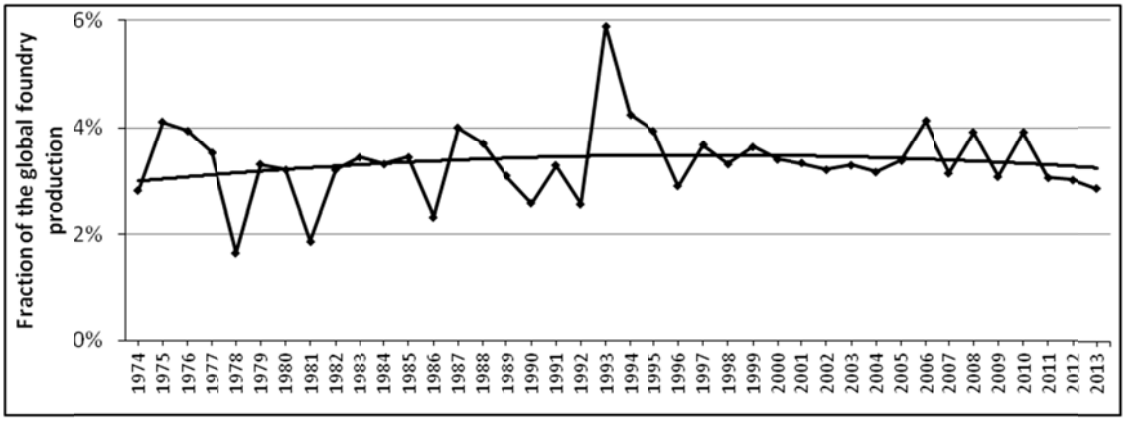

Fig. 13. The fraction of non-ferrous alloys (other than aluminium alloys) in the global production of castings over the years 1974-2013 [2-15, 17-42]

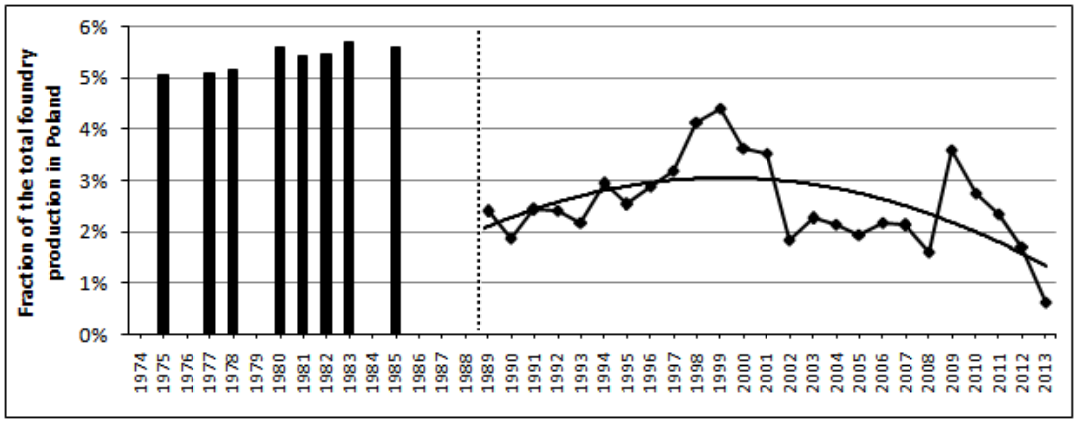

Fig. 14. The fraction of non-ferrous alloys in the total production of castings in Poland; the data for the 1975-1988 period include aluminium alloys; the data for the period 1989-2013 refer to non-ferrous alloys other than aluminium alloys [6-15, 28-42]

3. Conclusion

The analysis of data (see Fig. 1) allow to state that the currently achieved production volume of castings on a global scale (about 100 million tons) does not much exceed the production volume of the 1978-1980 period (about 88 million tons). A rapid decrease in the global production of castings (to the level of about 33 million tons) occurred in the years 1981-1983. A large decrease in the

production of castings occurred again during the last fifteen years of the considered period. It happened in 2009, when the global production fell to about 80 million tons from the level of about 93 million ton achieved in 2008.

According to F. Stręk [16], the largest total production of castings in Poland was achieved in 1977 (about 2650 thousand tons), while the statistics published by 'Modern Casting' point to the year 1978 (2528 thousand tons). A distinct downturn can be distinguished during the 1980-1992 period (see data in Fig. 2). By the year 1992 the foundry production volume in Poland decreased to the level of 759 thousand tons and for the subsequent eighteen years it does not achieved the level of one million tons. This limit was overcome only in 2012, and already in 2013 the production of castings in Poland reached almost 1.3 million tons.

It results from the above analysis that the fraction of grey cast iron and the malleable in the production of castings significantly decreased over the period of the past 40 years (see data in Figures 3, 4, 7, and 8). The fraction of production corresponding to the former of the mentioned alloys decreased from about 75-80% to about 45-55% in Poland, while on a global scale this value fell to even lower level (from about 65-75% to about 45%). The fraction of the latter of the alloys decreased substantially, and it is stabilised by now at the level of about 1% both in global scale and in Poland.

The fraction of SG iron distinctly increased on a global scale: from beneath 10% in the years 1974-1981 to about 25% reported during the 2008-2013 period (see Figure 5). The range of this growth was less in Poland (see Figure 6): from about 3% fraction in 1989 to 12-16% in the years 2007-2013. F. Stręk [16] reports that the fraction of SG castings in the production volume of ferrous castings in 1985 was only 2.7%. At the same time the corresponding value was equal to about 23% in Germany, 18% in England, 38% in France.

The tendencies with regard to the production of cast steel castings take a different course in Poland than in the world (see Figures 9 and 10). While the fraction of this alloy in global production of castings stabilised at the level of 8-11% over the past thirty years, a downward trend can be noticed in Poland (to about 4-7% over the past 10 years).

The significance of aluminium alloys as materials for the production of castings increased considerably over the past years. The fraction of these alloys in the global production of castings rose from about 3% to about 15% over the 1974-2013 period (see Figure 11). In Poland this growth was even larger: from about 3% in 1989 (the former data are lacking) to about 25-30% in the years 2011-2013 (see Figure 12).

The fraction of the non-ferrous alloys (aluminium excluded) in the global production of castings was equal to 3-4% over the analysed period of time (see Figure 13). In Poland, this fraction was at the similar level, exhibiting a slight downward trend during the 2009-2013 period (see Figure 14).

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