COMMISSION OF THE EUROPEAN COMMUNITIES

REVIEW OF STUDIES CARRIED OUT IN THE PRODUCER COUNTRIES ON THE FORECAST CONSUMPTION OF THE ALLOYING ELEMENTS
Ni, Cr, Mo, V, W and Co
FOR SPECIAL STEEL PRODUCTION IN THE YEARS 1980 AND 1985

1976

SERIES: RAW MATERIAL SUPPLY FOR THE IRON AND STEEL INDUSTRY – Part NO 1

'What is the long-term prospect for the consumption of alloying elements? Will the present phenomena of substitution of one alloying element for another, to obtain the same production result, continue in the years to come; or will others take over – and if so which?

In steel metallurgy what alternative uses are and will be possible for different forms and states of the same alloy?'.

Those are some of the multitude of questions that must be asked if the dangers threatening the regular supply of the iron and steel industry both in the immediate and long-term future are to be fully appreciated.

Thus studies have been carried out at Member State level in order to quantify the long-term needs for the most important alloying elements. The development of consumption and production of the alloy steels incorporating the major part of the alloying elements under consideration had to be examined. These steels were divided into four categories: construction steels, tool steels, stainless and refractory steels and high-speed steels. Subsequently consumption trends in the different alloy steel user sectors were analysed for each country of the Community. Certain conclusions have been able to be drawn as regards the future.

The developments of specific consumptions is of particular interest, expressing as they do, if only in an overall way, the phenomena of substitution and of intersubstitution, very important from the supply point of view, which are characteristic of the production and use of alloy steels.

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INTRODUCTION

This review reflects the general balance of opinion, which does not necessarily coincide fully with the viewpoint of all the experts, particularly in regard to the construction and interpretation of historical series.

The abrupt advent of the oil crisis, followed by the readjustments that have taken place since, have modified the background against which the previous hypotheses were formed. The rise in raw material prices and a new world balance - on top of the other factors tending towards a reduction of growth rates - have brought about a new situation in which the theory of continous growth has had to be rethought, and everyone is seeking to define objectives more appropriate to the most recent constraints of a rapidly changing economic environment.

The studies are based on the production statistics for 1975 and the years before (1); the forecasts given in this review for the years 1980 and 1985 were drawn up in 1974 and revised during 1976.

(1) Producer countries :

- B : Benelux
- D : BR Deutschland
- F : France
- I : Italia
- UK : United Kingdom

PREMISE

The aim of the research is to find a hypothesis on which to base forecasts of the consumption, in the years 1980 and 1985, of the alloying elements Ni, Cr, Mo, V, W and Co, used in the production of special steels.

The term "consumption" has therefore been defined as the total quantity contained in ingots and continuously cast billets. The following have been disregarded :

- the origin of the metal, which may be used in pure form, (e.g. ferro-alloys or oxides) or contained in scrap, pig iron, etc. ;
- its yield in the furnace ;
- losses, etc...

As thus defined, consumption does not represent the quantity of new metal needed for supply, because it disregards the losses and includes, for instance, the quantity recycled in the steelworks.

The origin of the metal, its input state and the quantity of new metal are therefore being made the subject of special studies.

The percentage of metal contained in special steels belonging to a specified category has been defined by the term "mean specific content" (the ratio of total consumption to steel production) owing to the variation in the wastage rate.

This percentage can be calculated from the mean content in the steel either when it leaves the steelworks (% of weight of ingots and continuously cast billets) or at the time of delivery (% of weight of finished products). Depending on the control stage, the quantity by weight contained in the steel will obviously differ. To obtain the quantity charged into the furnace, we must add in the first case the quantities lost in the furnace, and in the second case both the furnace losses and the quantities recycled or lost during hot or cold working.

The final quantities thus calculated should correspond to the consumption shown in the records of the steelworks.

For the purposes of the research objective, it was decided to determine the mean specific content as a function of the ratio between the steel produced and the alloying elements contained in it : to these values, the variations of trend have been applied.

The consumption forecast for 1980 and 1985, however, has been obtained from the hypothetical quantity of steel produced in each category, multiplied by the mean specific content for each element.

The working party is aware of the importance of the charging condition of the alloying elements and the variation in the losses depending on the type of steel and the steelmaking method (special studies are in progress to examine the economic, technological, evolutive and ecological aspects).

In view of the fact that a knowledge of the percentage losses relative to the quantity contained in the ingots makes it possible to calculate the quantity of alloying elements to be supplied, the working party decided to carry out its own research to determine the quantity of each alloying element that can be affected solely by changes in the specific content, i.e. the quantity contained in the ingots and continuously cast billets.

CHANGES IN THE MEAN SPECIFIC CONTENT

The analyses carried out during the studies have shown the complexity of the methods of investigation required to determine the reasons for changes in the specific contents. The effect of many different factors has been examined, and in some cases it has been possible to relate cause and effect (e.g. the substitution of molybdenum for tungsten in high-speed steels, or the increase in ferritic and martensitic components in stainless steels relative to austenitic components); in many other cases, there are a number of factors involved, usually interdependent.

In such a complex situation it is very difficult to talk about substitution, but a classification of the determining factors has nevertheless been proposed to help in distinguishing various phenomena :

Determining factors	Effects	Examples
INTERNAL		
Scarcity and price ↓	Substitution of elements at the level of type or class	W → Mo (high-speed steels)
Technical innovations ↓	Substitution of elements at the level of type, class or category	ferritic ⇄ ⇄ austenitic (stainless steels)
Economic choice of consumption ⇅	Substitution of elements at the level of type, class or category, Substitution by other materials.	Choice of lower alloy types
EXTERNAL		
Economic trend and variations in demand	Major changes in the demand from various branches of industry for certain types, classes or categories of steel.	Long-term slowdown in the motor vehicle industry, or expansion in other sectors.

Constructional steels

This class of steels includes the alloy constructional steels, bearing steels, steels with special physical properties and lower-alloy steels (Sonderbaustähle) (1).

Despite their varied uses and the resulting differences in market structure, the products fabricated and the ratios between them have remained fairly constant over the past 10 years. In all the Community countries, the trend shows similar features. In the first place, there is a constant tendency to cut down the higher-alloy steels in favour of lower-alloy steels. Secondly, substitutions are observed between alloy steels and carbon steels which are hard to quantify. This makes it all the trickier to predict the exact future trend of production.

A better knowledge of steels and their behaviour has led to more rational use of alloying elements. Then again, the progress made in technology and metallurgy has resulted in greater use being made of low-alloy steels (e.g. boron steels), with consequent variations in the mean specific content of alloying elements.

The change in the content of nickel - once the basic element in the alloy constructional steels - is a typical example of this phenomenon. Although the conditions for the use of this element vary from one Community country to another, it is to be expected that its specific content in the years 1980 and 1985 will be less than in 1968 : the declining trend evident in past years will continue in the years to come, though somewhat less sharply.

The rate of this decline, however, will vary according to the country, and the average nickel content will be affected by economic vicissitudes and also by the demand for anti-magnetic steels and steels with good strength properties at low temperatures; in the case of these steels, the annual fluctuations are greatly accentuated by their high nickel content and wastage rate.

Against this, the specific chromium content seems on the whole likely to remain fairly steady in spite of a slight upward trend in consumption. The development in regard to this element is much the same in all the Community countries. The forecasts of a future increase in the mean molybdenum content are linked with the forecast requirements for steels with a high creep resistance.

There is also likely to be an appreciable rise in vanadium contents owing to the increasing use of steels with a high yield strength, which make for lighter construction. In this connection, vanadium has growing

(1) This class of steels raises difficult statistical problems, as it is only since 1969 that they have been classified as special steels. In accordance with the new Euronorm 20/74, some grades of steel that were formerly classified as special steels have been classified since 1975 as quality steels, thus giving rise to a new break in the statistical series.

importance as an addition element in chromium and nickel steels.

The use of tungsten in constructional steels is so limited that it can virtually be disregarded.

The same is true of cobalt, though it seems that its use might increase owing to certain technological developments.

Whether because of variations in the specific content at type level or because of substitution at class or category level, the overall trend in the mean contents of alloying elements presents the following picture :

Constructional steels
kg alloying metal per 100 kg of production (1)

	1968	1972	1973	1974	1975	1980	1985
Nickel	0.36	0.32	0.32	0.34	0.32	0.32	0.32
Chromium	0.70	0.59	0.63	0.64	0.61	0.66	0.66
Molybdenum	0.11	0.09	0.10	0.11	0.11	0.11	0.12
Vanadium	0.012	0.020	0.019	0.021	0.022	0.024	0.023

Even though the hope of rapidly recovering the ground lost in 1975 in the Community as a whole has now faded, the prospects of the constructional steel markets are thought to be good in all the member countries. It is considered that the production of alloy constructional steels will go on increasing at a satisfactory rate, though there may be a slow-down during the period 1980-85.

On the basis of the evaluation outlined above, the requirements for alloying elements in the Community's constructional steel sector will follow the pattern shown in the following table, in which the 1972 figures are taken as the index 100 :

(1972 = 100)	1975	1980	1985
Nickel	111	143	160
Chromium	113	159	179
Molybdenum	133	168	200
Vanadium	119	168	183

With regard to the elements chromium and vanadium, it should be borne in mind that the specific consumption of chromium in the Community was less in 1972 than in 1968 whereas the Community's vanadium requirement nearly doubled between 1968 and 1975.

(1) This figure includes new alloying metal as well as that obtained from scrap.

Constructional steels

Mean specific contents %

COUNTRY	1968	1972	1973	1974	1975	1980	1985	ALL. EL.
B	-	-	0.10	0.15	0.19	0.09	0.09	Ni nickel
D	0.22	0.25	0.23	0.27	0.26	0.27	0.29	
D	-	0.05	0.08	0.07	0.08	0.08	0.08	
F	0.49	0.45	0.47	0.55	0.45	0.47	0.40	
I	0.40	0.38	0.41	0.44	0.39	0.34	0.31	
UK	0.46	0.45	0.49	0.49	0.49	0.49	0.49	
EUR 9	0.36	0.32	0.32	0.34	0.32	0.32	0.32	
B	-	-	1.11	0.79	0.88	0.50	0.50	Cr chromium
D	0.85	0.95	0.91	0.93	0.94	1.00	1.05	
D	-	0.07	0.10	0.10	0.08	0.12	0.12	
F	0.82	0.76	0.73	0.78	0.72	0.71	0.69	
I	0.74	0.77	0.84	0.82	0.77	0.87	0.88	
UK	0.47	0.46	0.60	0.50	0.50	0.50	0.50	
EUR 9	0.70	0.59	0.63	0.64	0.61	0.66	0.66	
B	-	-	0.14	0.15	0.18	0.08	0.08	Mo molybdenum
D	0.09	0.12	0.10	0.12	0.14	0.13	0.14	
D	-	0.01	0.02	0.01	0.02	0.02	0.03	
F	0.14	0.13	0.13	0.17	0.18	0.17	0.16	
I	0.11	0.12	0.11	0.11	0.11	0.13	0.14	
UK	0.12	0.12	0.13	0.13	0.12	0.14	0.15	
EUR 9	0.11	0.09	0.10	0.11	0.11	0.11	0.12	
B	-	-	0.012	0.010	0.011	0.02	0.02	V vanadium
D	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
D	-	0.07	0.06	0.05	0.05	0.05	0.05	
F	0.019	0.017	0.013	0.012	0.018	0.016	0.018	
I	0.014	0.017	0.012	0.011	0.014	0.020	0.021	
UK	0.002	0.002	0.002	0.002	0.002	0.002	0.002	
EUR 9	0.012	0.020	0.019	0.021	0.022	0.024	0.023	
								W tungsten
EUR 9	-	-	-	-	-	-	-	
F	0.029	0.026	0.031	0.027	0.020	0.025	0.023	Co cobalt
EUR 9	-	-	-	-	-	-	-	

Trend in Community requirements for alloying elements

Constructional steels

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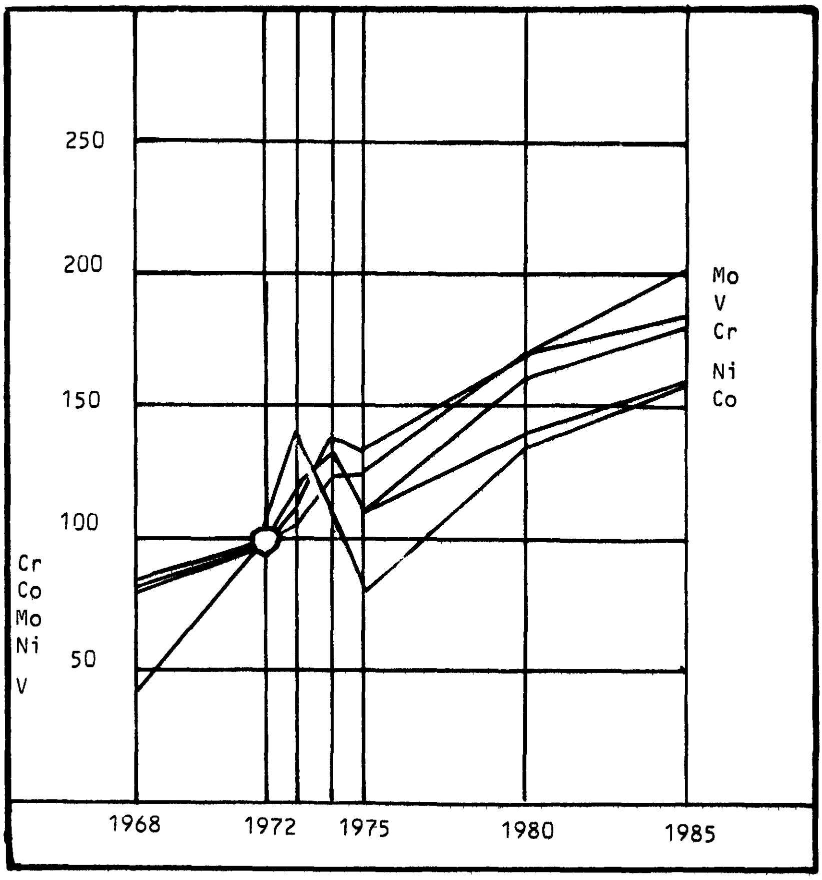

Stainless and heat-resisting steels

In the recent Community production, the variations in mean specific contents in the category of stainless steels - which also includes heat-resisting steels - are such that no major changes need be forecast for 1980 and 1985. This might lead one to suppose that these steels, which have developed rapidly over the last 30 years, have now reached a very high level of technical sophistication.

The fact is, however, that underlying these slight variations in the mean specific contents there are quite a lot of complex changes.

At Community level, the reduction in the mean specific content of nickel from 6.81 in 1974 to 6.06 in 1985 (more marked in France, Germany and Italy, less so in Benelux and the UK) indicates a drop in the proportion of austenitic steels within the overall category of stainless steels relative to the current level (which ranges from 50 to 70% in different countries).

The improvement of the Cr+Mo steels and the development of steels containing manganese and nitrogen help to lower the mean nickel content.

These phenomena do not, of course, affect the chromium content, which, after steadily increasing from 15.13 in 1968 to 16.84 in 1975 (probably due to the development of 18 Cr steels in relation to the martensitic steels with 13 Cr), now seems to be stabilizing at a mean content of around 17.2 in all the countries, despite some differences in the absolute value.

Molybdenum, the third most important alloying element in stainless steels, shows remarkable stability within the Community with a mean specific content of 0.40/0.45-a fact which is surprising since technological developments seem to favour the use of this metal. This stability, however, is not confirmed by the forecasts of all the producer countries, some of which foreshadow a rapid growth rate. With the information currently available, therefore, it is difficult to make any firm pronouncement.

Compared with the other alloying elements, cobalt is quantitatively unimportant. The decline in its use is still continuing - probably due to the very slight development of cobalt - bearing steels in relation to the category as a whole, and to the competition from non-ferrous alloys.

Overall, the trend in the mean contents of alloying elements is as follows :

Stainless and heat-resisting steels
kg alloying metal per 100 kg production

	1968	1972	1973	1974	1975	1980	1985
Nickel	6.10	6.27	6.24	6.81	6.53	6.62	6.06
Chromium	15.13	16.85	16.89	18.47	16.84	17.15	17.26
Molybdenum	0.35	0.34	0.36	0.46	0.40	0.42	0.46

Taking the 1972 figures as the index 100, the requirements for alloying elements in the stainless steel sector will evolve as follows :

(1972 = 100)	1975	1980	1985
Nickel	93	166	179
Chromium	89	160	19
Molybdenum	106	198	253

Stainless and heat-resisting steels

Mean specific contents %

COUNTRY	1968	1972	1973	1974	1975	1980	1985	ALL.EL.
B	12.0	9.4	9.60	9.68	9.88	9.30	9.30	Ni nickel
D	6.84	7.07	7.11	7.65	7.46	7.30	7.30	
F	6.43	5.28	5.01	5.30	5.30	5.12	4.75	
I	5.64	5.56	5.61	5.80	6.03	5.2	5.0	
UK	6.56	6.2	6.2	6.2	6.2	6.2	6.2	
EUR 9	6.10	6.27	6.24	6.01	6.53	6.62	6.06	
B	13.2	20.1	17.63	17.58	17.86	20.8	20.8	Cr chromium
D	16.75	17.01	16.72	20.90	17.07	17.0	17.0	
F	17.36	17.20	17.10	16.63	17.00	17.00	17.08	
I	14.29	16.51	15.51	15.90	15.99	17.5	17.5	
UK	14.75	16.5	16.5	16.5	16.5	16.5	16.5	
EUR 9	15.13	16.85	16.89	18.47	16.84	17.15	17.26	
B	0.51	0.25	0.26	0.26	0.24	0.25	0.25	Mo molybdenum
D	0.48	0.40	0.43	0.50	0.50	0.55	0.55	
F	0.27	0.26	0.26	0.29	0.33	0.30	0.38	
I	0.26	0.25	0.28	0.29	0.35	0.40	0.50	
UK	0.49	0.50	0.50	0.50	0.50	0.52	0.52	
EUR 9	0.35	0.34	0.36	0.46	0.40	0.42	0.46	
D	0.01	0.01	0.01	0.01	0.01	0.01	0.01	V vanadium
EUR 9								
D	0.01	0.01	0.01	0.01	0.01	0.01	0.01	W tungsten
EUR 9								
D	0.03	0.01	0.01	0.01	0.02	0.02	0.02	Co cobalt
F	0.048	0.019	0.017	0.020	0.020	0.016	0.016	
EUR 9								

Trend in Community requirements for alloying elements

Stainless and heat-resisting steels

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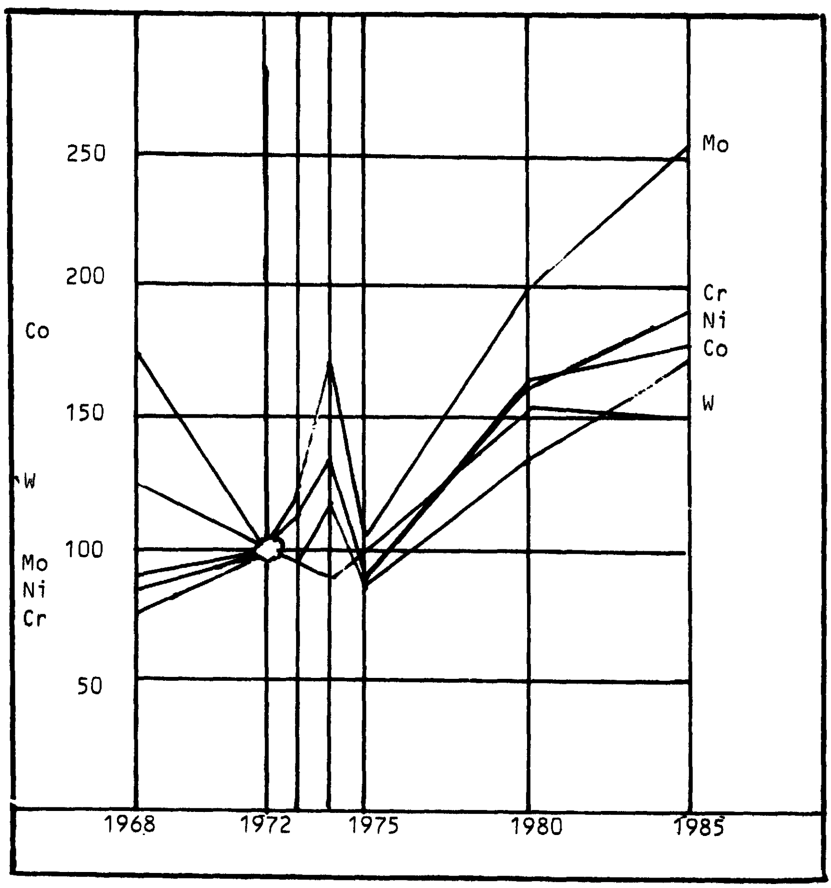

Tool steels

With regard to tool steels, the major differences of composition in steels intended for different applications, together with the scarcity of statistical information, make it necessary to give a critical interpretation of the mean specific contents recorded in Community production.

An actual increase in these contents is found only in the case of molybdenum and vanadium, though there is likely to be a progressive improvement in the qualities and steelmaking techniques of these steels.

Nickel, which is really only used in one group of steels (for hot working) is estimated to be either increasing or decreasing according to the country; its mean specific content, however, remains fairly constant, and the disparity between the producer countries will have levelled off by 1985.

Chromium, the most important alloying element for tool steels, will remain constant (2.41 in 1985 as against 2.39 in 1968), with mean values that differ widely from country to country owing to the different traditions in production and marketing. It would seem that, despite rapid technological change, the levelling off predicted for 1980 and 1985 will not be achieved.

Molybdenum and vanadium show the greatest increase in mean specific content. From 0.27 in 1968, molybdenum will reach 0.34 in 1985. Its characteristics with respect to hardening and heat resistance give it multi-purpose usefulness, sometimes at the expense of tungsten.

Similarly, the consumption of vanadium is on the increase owing to its effect on cold and hot tool life, and its mean specific content will rise from 0.12 in 1968 to 0.16 in 1985.

Though partially ousted by molybdenum, tungsten holds its position of importance with a mean specific content which varies only within narrow limits.

Lastly, we come to cobalt, which is used only in very specialized grades : its mean specific content is too small to have any significance. There may well be some increase in cobalt consumption owing to its usefulness for improving the hot behaviour of steels.

Tool steels

kg alloying metal per 100 kg production

	1968	1972	1973	1974	1975	1980	1985
Nickel	0.46	0.37	0.41	0.39	0.44	0.42	0.41
Chromium	2.39	2.47	2.57	2.36	2.30	2.45	2.41
Molybdenum	0.27	0.31	0.33	0.30	0.30	0.33	0.34
Vanadium	0.12	0.12	0.15	0.13	0.12	0.15	0.16
Tungsten	0.21	0.19	0.28	0.20	0.14	0.18	0.17

Taking the 1972 figures as the index 100, the requirements for alloying elements in the tool steel sector will evolve as follows :

(1972 = 100)	1975	1980	1985
Nickel	123	148	151
Chromium	97	129	135
Molybdenum	101	140	153
Vanadium	103	162	179
Tungsten	75	121	124

Tool steels

Mean specific contents %

COUNTRY	1968	1972	1973	1974	1975	1980	1985	ALL.EL.
D	0.49	0.42	0.46	0.40	0.47	0.50	0.50	Ni
F	0.65	0.43	0.50	0.50	0.50	0.44	0.43	
I	1.02	0.80	1.05	1.01	0.96	0.60	0.40	
UK	-	0.0	INADEQUATE	STATISTICAL	DATA	-	-	
EUR 9	0.46	0.37	0.41	0.39	0.44	0.42	0.41	nickel
D	2.40	2.44	2.48	2.25	2.21	2.25	2.25	Cr
F	3.41	3.62	3.90	3.78	3.60	3.35	3.14	
I	2.04	3.15	3.17	2.69	3.13	4.90	4.75	
UK	-	3.08	INADEQUATE	STATISTICAL	DATA	3.50	3.50	
EUR 9	2.39	2.47	2.57	2.36	2.30	2.45	2.41	chromium
D	0.27	0.30	0.29	0.26	0.28	0.30	0.30	Mo
F	0.29	0.42	0.50	0.47	0.46	0.44	0.43	
I	0.43	0.60	0.80	0.63	0.50	0.80	0.90	
UK	-	0.34	INADEQUATE	STATISTICAL	DATA	0.38	0.38	
EUR 9	0.27	0.31	0.33	0.30	0.30	0.33	0.34	molybdenum
D	0.12	0.13	0.13	0.13	0.12	0.15	0.15	V
F	0.03	0.05	0.13	0.12	0.13	0.11	0.11	
I	0.13	0.26	0.41	0.21	0.18	0.25	0.40	
UK	-	0.24	INADEQUATE	STATISTICAL	DATA	0.27	0.27	
EUR 9	0.12	0.12	0.15	0.13	0.12	0.15	0.16	vanadium
D	0.21	0.22	0.31	0.20	0.13	0.20	0.20	W
F	0.18	0.10	0.12	0.10	0.09	0.08	0.08	
I	0.10	0.11	0.32	0.22	0.19	0.02	0.02	
UK	-	0.34	INADEQUATE	STATISTICAL	DATA	0.45	0.40	
EUR 9	0.21	0.19	0.28	0.20	0.14	0.18	0.17	tungsten
D	0.02	0.03	0.02	0.02	0.03	0.03	0.03	Co
F	0.02	0.02	0.04	0.02	0.02	0.018	0.016	
I	0.02	-	-	-	-	-	-	
UK	-	-	INADEQUATE	STATISTICAL	DATA	0.13	0.13	
EUR 9	0.028	0.031	0.030	0.026	0.027	0.032	0.031	cobalt

Trend in Community requirements for alloying elements

Tool steels

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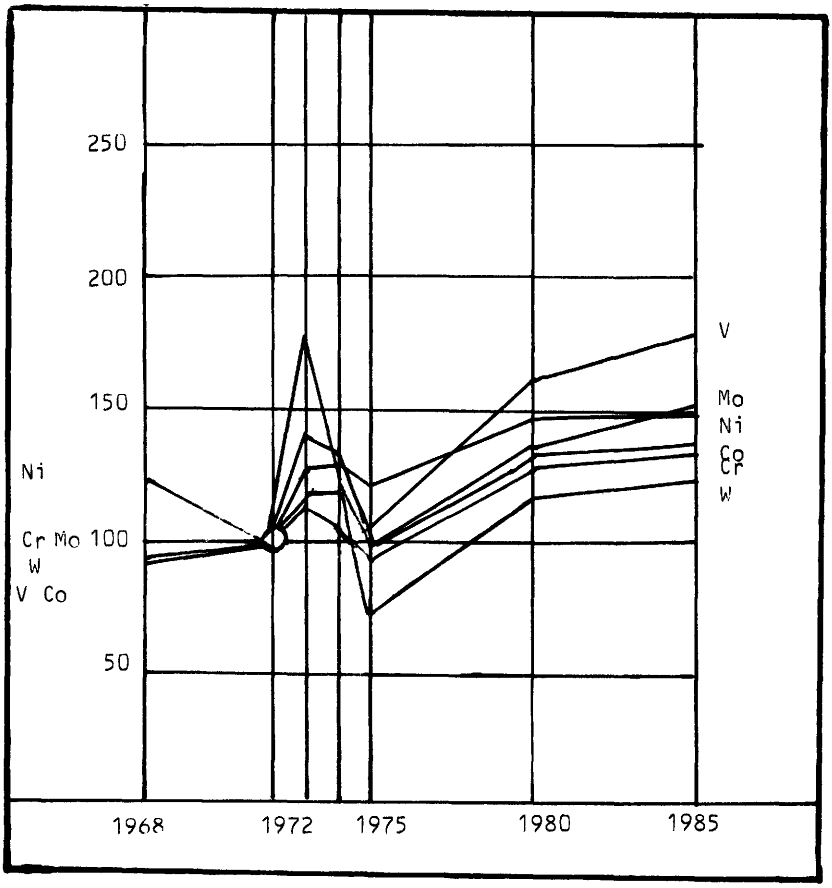


High-speed steels

In high-speed steels, perhaps more than in any other sector, we find one alloying element being substituted for another with a view to giving the steel the right characteristics for the purpose for which it is intended. In this case, it is molybdenum that is being substituted for tungsten.

Initially an expedient to cope with supply difficulties and instability of prices, this substitution has now become permanent owing to the real technical advantages it offers. The changeover has taken place in all the producer countries, though more or less rapidly, depending on tradition or commercial factors.

At Community level, it is predicted that the specific content of tungsten will drop from 8.55 in 1968 to about 6.35 in 1985, and conversely that molybdenum will show an increase from 3.55 to somewhere around 5.0.

The increase in molybdenum might be still greater if the steels with a high specific content of that metal were to develop more rapidly than predicted.

The chromium content will remain constant at around 4. The variations in the vanadium content are likewise insignificant (it is expected to rise from 2.04 to 2.10). According to some experts, it is possible to raise the yield point and strength of steels by acting on both molybdenum and chromium : this might lead to a drop in the specific consumption of vanadium.

Finally, we come to cobalt, which, despite a fall-off during the most recent statistical period, is generally expected to show an upward trend owing to its utilization in grades of steel intended for special uses and "high specialization".

Overall, the trend in the mean contents of alloying elements is as follows :

High-speed steels
kg alloying metal per 100 kg production

	1968	1972	1973	1974	1975	1980	1985
Chromium	3.97	4.03	4.08	3.70	3.94	4.03	4.00
Molybdenum	3.55	4.17	4.44	4.02	4.40	4.61	4.98
Vanadium	2.04	2.11	2.20	1.96	3.31	2.12	2.10
Tungsten	8.55	7.51	7.39	6.72	7.02	6.78	6.34
Cobalt	1.28	1.07	1.12	1.07	1.29	1.21	1.16

The requirements for alloying metals in the high-speed steel sector, taking 1972 as 100, will be as shown in the following table :

(1972 = 100)	1975	1980	1985
Chromium	85	113	124
Molybdenum	107	146	173
Vanadium	146	122	133
Tungsten	84	105	108
Cobalt	108	132	139

High-speed steels

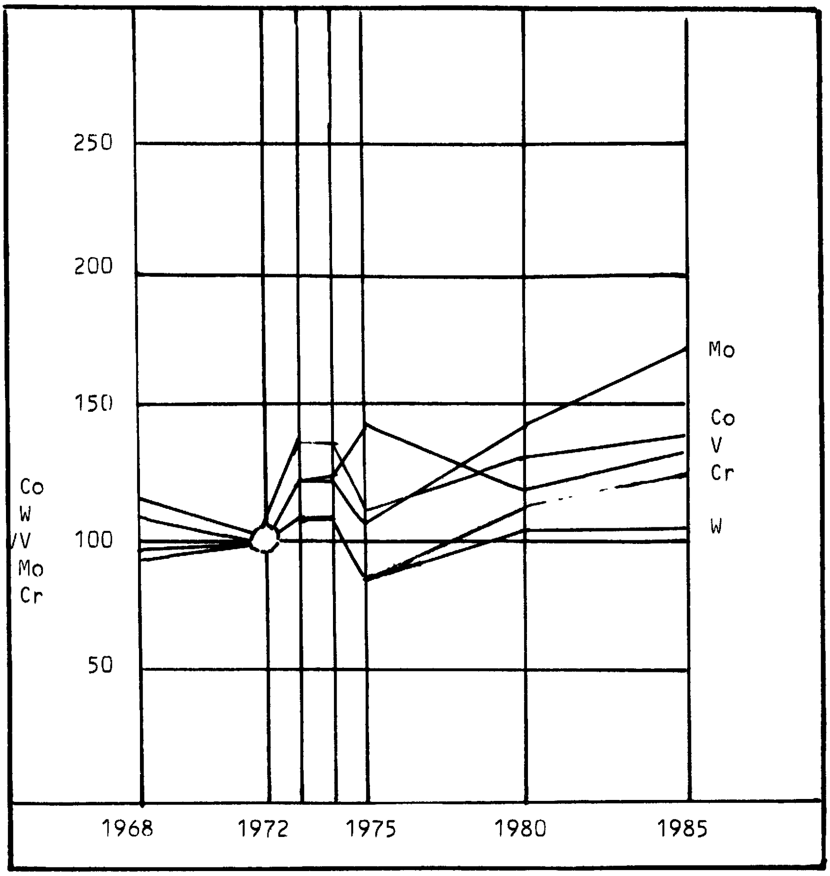
Mean specific contents %

COUNTRY	1968	1972	1973	1974	1975	1980	1985	ALL. EL.
								Ni nickel
EUR 9	-	-	-	-	-	-	-	
D	4.14	4.14	4.16	3.89	4.14	4.2	4.2	Cr chromium
F	4.02	4.05	4.03	4.00	4.03	4.0	4.0	
I	2.82	3.21	2.92	2.00	2.50	4.0	4.0	
UK	3.37	3.80	4.03	3.87	3.90	3.8	3.8	
EUR 9	3.97	4.03	4.08	3.70	3.94	4.03	4.00	
D	4.18	4.25	4.46	3.86	4.15	4.5	4.5	Mo molybdenum
F	3.76	4.66	4.58	4.76	4.97	5.2	6.0	
I	1.82	3.71	3.33	3.33	3.38	4.6	5.5	
UK	2.38	3.59	4.29	4.12	4.21	4.15	4.25	
EUR 9	3.55	4.17	4.44	4.02	4.40	4.61	4.98	
D	2.05	1.97	1.98	1.83	1.96	2.0	2.0	V vanadium
F	1.89	1.95	2.02	1.97	1.95	1.98	1.99	
I	1.59	2.00	2.08	1.63	1.62	1.8	2.0	
UK	2.12	2.38	2.59	2.47	2.47	2.59	2.40	
EUR 9	2.04	2.11	2.20	1.96	3.31	2.12	2.10	
D	7.25	7.07	7.09	7.20	7.86	7.2	7.2	W tungsten
F	9.11	7.06	6.64	6.44	6.15	5.99	5.00	
I	8.00	9.00	12.50	7.04	5.74	6.0	6.0	
UK	10.70	8.23	7.58	7.25	7.38	7.25	7.00	
EUR 9	8.55	7.51	7.39	6.72	7.02	6.78	6.34	
D	1.62	1.32	1.36	1.38	1.93	1.6	1.7	Co cobalt
F	1.07	0.82	0.90	0.90	0.87	0.76	0.61	
I	1.71	1.50	1.38	1.00	0.82	1.5	1.2	
UK	0.77	0.85	0.89	0.95	1.11	1.0	1.0	
EUR 9	1.28	1.07	1.12	1.07	1.29	1.21	1.16	

Trend in Community requirements for alloying elements

High-speed steels

INDEX TREND



CONSUMPTION FORECASTS

The consumption forecasts for alloying elements in 1980 and 1985 - based either on the mean specific content or on the quantity of steel produced - have been presented by the experts as working hypotheses, and followed up by a number of more detailed studies carried out by national groups in the context of the "General Objectives for Steel". The latter presuppose a number of economic options and, in particular, a knowledge of the kind of development that might be envisaged. Despite all the uncertainty of the forecasts, which are affected on the one hand by the dynamics of a satisfactory rate of development, and on the other by factors limiting growth (e.g. birth control, a worsening of the supply situation for raw materials, greater concern for the environment, the unpredictable rate of industrialization in the developing countries, and technological progress), the hypotheses that have been put forward can be regarded on the whole as worthy of serious attention. The studies carried out by the System Dynamic Group of the Massachusetts Institute of Technology (MIT) on behalf of the Club of Rome, and those executed by UNESCO in preparing the report "Apprendre à etre", have been cited as an important source of information.

Indeed, there are many factors that could affect future production, such as probable changes in the industrial structures brought about by growth, technological development (which affects losses and recycling), the saturation of forecast requirements or a new situation resulting from the energy crisis or the availability of raw materials.

The hypothesis adopted was based, of course, on the statistical data for the period 1960-75. The extrapolation of this reference data was calculated according to different criteria but, generally speaking, it was agreed that, from a certain date onwards (prior to 1985), a change would take place in the growth model, preceded by a drop in the growth rate. Depending on the national situation, this phenomenon was differently evaluated.

A very thorough investigation has been made into the question of the relation between the consumption of the special alloy steels and the production of the user industries; this relation - together with the forecast development in each sector - was the basis on which the relative quantities of steel were calculated. According to this criterion, the consumption V during the period t can be calculated by the following equation :

$$V_t = I_t \cdot K_t$$

where I_t is the production index of the user industry during the period concerned, and K_t its specific consumption of special alloy steels during the same period. This method raises the question of a thorough study of the structure of the market for special steels in general, and alloy steels in particular.

Since all the studies concede that, for a long period of time, the fluctuations in stocks will balance each other out, the final consumption of alloying elements has been calculated on the basis of supplies to the market (including exports) plussed up by the internal consumption of the steelworks (i.e. according to production). These statistical data, however, do not give a true picture of the final consumption of steel in each user sector, as a substantial portion is supplied to the intermediate processing industries. It was therefore necessary to carry out separate investigations in order to apportion among the user industries the statistical quantities recorded as deliveries to the processing industries.

A similar situation occurs in the case of quantities imported or supplied to the trade, and here again the same research has been carried out.

As Community statistics take in both the intermediate processing industries and the final user industries, each of the studies has grouped these industries into separate basic categories in order to use the available data of the country. The classifications finally adopted are shown in the table below :

Eisenschaffende Industrie Stahlverformung	forge, estampage tubes transformation à froid	forgia, stampaggio tubi lav.a freddo prod. lunghi lav.a freddo prod. piatti bullonerie molle	bolts, nuts, screws ... wire and wire manufacture drop forging
Stahlbau Maschinenbau Fahrzeugbau Elektrotechnik E B M - Industrie Bauindustrie Chemie	machines non électriques machines électriques et électroniques matériels de transport batiment et travaux publics articles métalliques et outillage chaudronnerie autres industries	impianti costruzione trasporti via acqua trasporti su rotaia trasporti su strada macch.p.lavor. terre meccanica contenitori costruz.edili o articoli metallici	coal mining iron and steel non-electrical machinery and construction tools and implements electrical vehicles other metal industries (') all other activities (*)
	revendeurs	commercio	merchants imports exports

(') metal boxes, metal furniture, hollow-ware, springs,miscellaneous ...
(*) food, chemical ind., gas, electricity,water, transport, all other cons.

The influence of exports on production called for much more complicated calculations, since it is bound up more with commercial than industrial activities, as well as with the future of the receiving countries, which is an unknown quantity. Depending on the circumstances, it was either assumed that the ratio of imports to exports would remain constant, or a constant or varying export rate was forecast. The inaccuracy of the estimates of exports in relation to national consumption throws doubt on the corresponding production forecasts and does not permit any definite conclusions regarding the consumption of alloying elements.

In spite of all this uncertainty, however, a hypothesis has been formed for the overall consumption of alloying elements in the producer countries of the European Community, as set out in the annexed tables and diagrams. It possesses all the required characteristics of a logical forecast.

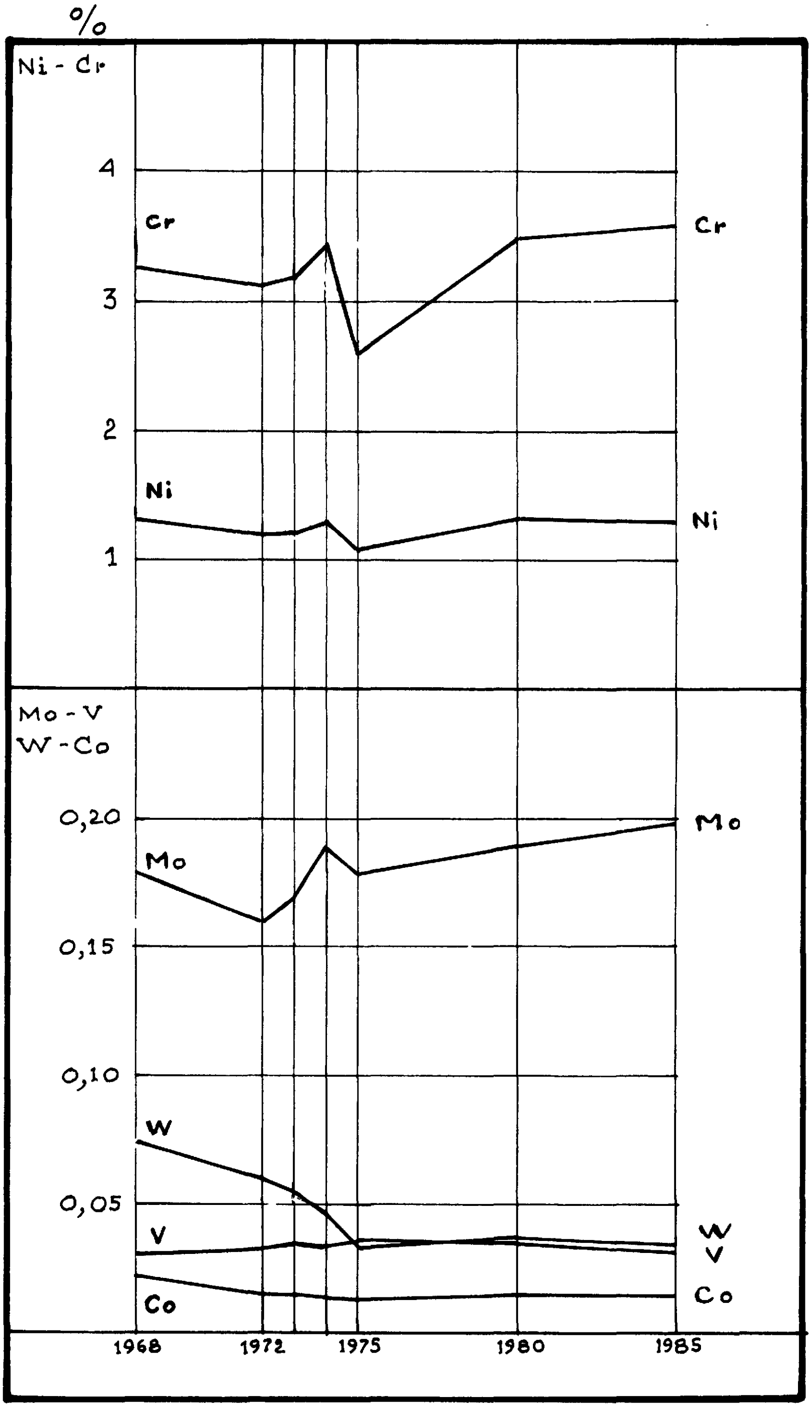
<u>Total production of alloy steels</u>

Mean specific contents - Consumption of alloying elements (input)

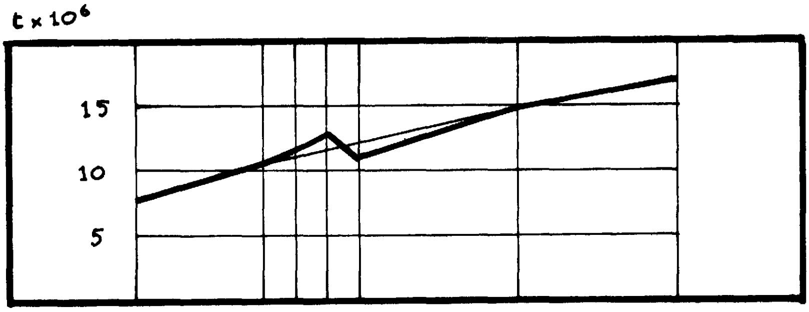
		1968	1972	1973	1974	1975	1980	1985
	PRODUCTION							
$t \times 10^3$	EUR 9	7,898	10,327	11,496	12,663	11,057	14,800	16,900
	MEAN SPECIFIC CONTENT							
%	Ni	1.34	1.22	1.23	1.33	1.10	1.36	1.30
	Cr	3.27	3.14	3.21	3.44	2.72	3.47	3.57
	Mo	0.18	0.16	0.17	0.19	0.18	0.19	0.20
	V	0.030	0.034	0.034	0.033	0.038	0.035	0.033
	W	0.073	0.057	0.054	0.047	0.033	0.038	0.034
	Co	0.022	0.015	0.017	0.015	0.013	0.015	0.014
	TOTAL CONSUMPTION OF ALLOYING ELEMENTS							
t	Ni	105,648	125,615	140,868	168,462	121,416	202,000	220,000
	Cr	258,180	323,926	368,506	436,087	300,355	510,000	600,000
	Mo	14,440	16,760	19,599	24,191	19,546	28,400	34,600
	V	2,360	3,469	3,904	4,223	4,309	5,150	5,650
	W	5,764	5,232	6,219	5,924	4,343	5,650	5,800
	Co	1,735	1,597	1,977	1,881	1,472	2,200	2,450

Note : Owing to lack of full statistical information for all the countries producing alloy steels in the Community of the Nine, some partial data have been estimated. Nevertheless, the overall accuracy is very satisfactory.

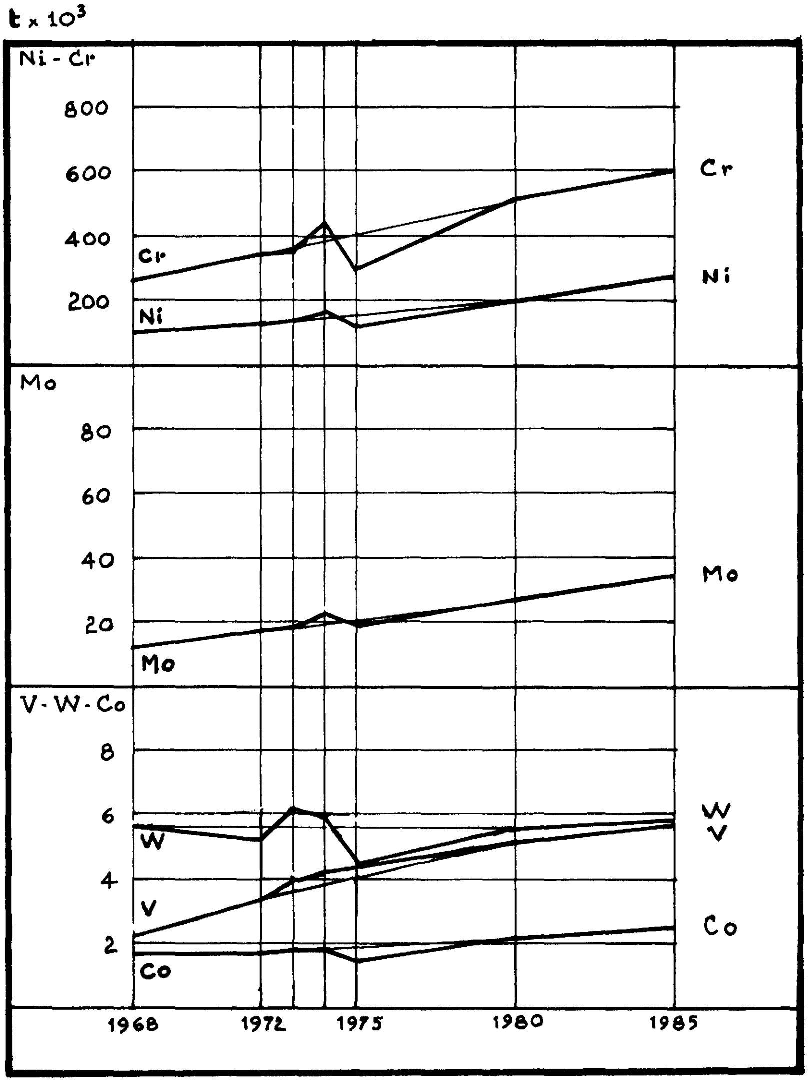
Mean specific content of alloying elements



Alloy steels production



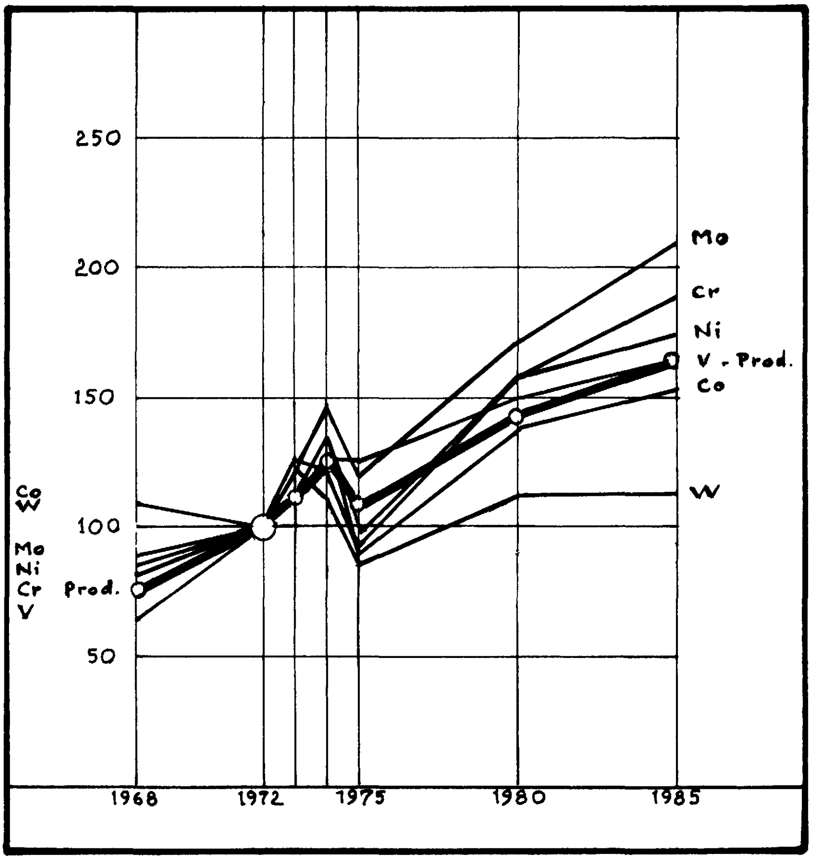
Alloying elements consumption



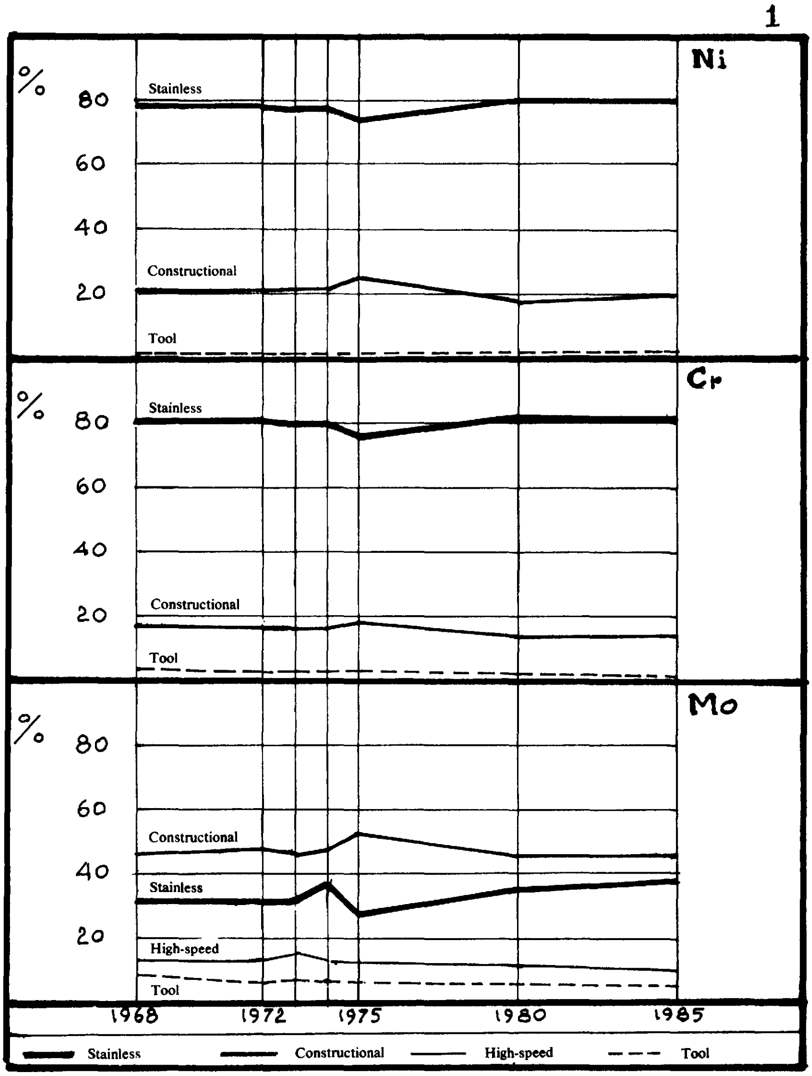
Trend of Community requirements for alloying elements

Alloy steels

INDEX DEVELOPMENT



Relative consumption of alloying elements



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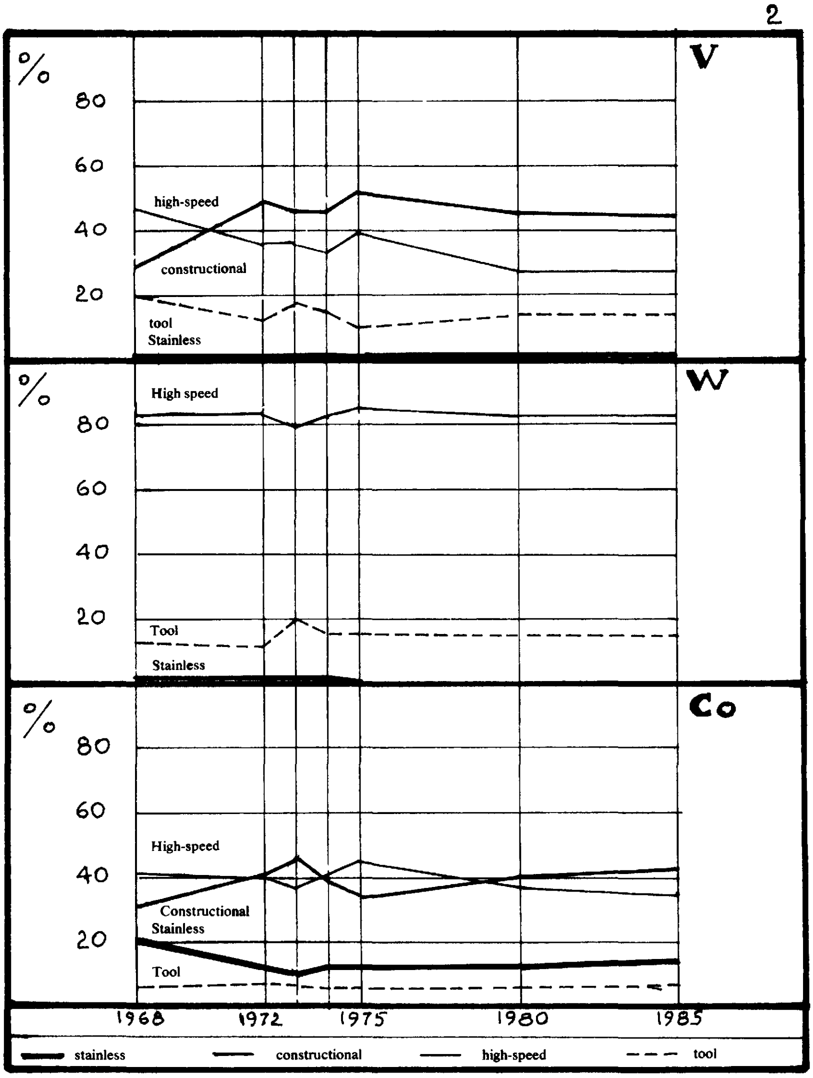
Relative consumption of alloying elements



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