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An approach to select Scrap and alloy surcharge mechanism for steel buying: Case study

Jaideep Gopale (Dy. General Manager)

An Independent Researcher

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Abstract - Pricing is an important area of Business economics and organization success largely depends on how material purchase strategies are defined. Steel raw material being major component of total price in manufacturing industry, it's important to have right approach defined in Steel raw material buying which avoids in financial losses to organization. This paper is an attempt to financially analyse scrap and alloy surcharge mechanism used by steel industries for monthly / quarterly pricing to their customers and further adopted by OEM or Manufacturing Industries over spot buying purchasing strategy.

Key Words: Prices, Steel, Alloy, Scrap, Surcharge, Purchase

1.INTRODUCTION

Defining the steel buying process and strategies are always complicated due to its requirement of in depth knowledge about commodities and factors affecting those commodities. Aim of steel sourcing and purchasing is always to reduce purchasing spend with right purchase price. Steel buyers always use their experience during steel buying and further defining strategic approach which is more over similar, no matter what industry the steel buyer are in. If we look back one or two decade, steel industry has always experienced high volatility of steel prices and those were largely depends on mining or production of base material or Ferroalloys; which in some cases were controlled to influence prices.

Steel raw material buying can be done with short term agreement and long term agreement. Short term price agreement strategy is mainly based on spot buying based on need. Where as in long term price strategy is derived considering major variables of steel prices and linking these variables with local or global indexes. If we consider alloy steel manufacturing process with Electric arc furnace then major price variables are Scrap and typical alloys required to manufacture particular grade.
This paper will evaluate approach of scrap and alloy surcharge model which is built on chemical composition of particular steel. And it's effectiveness financially for savings or losses over estimated spend.

2. Steel manufacturing and pricing

2.1 Steel Manufacturing process:

Basic Iron is made by mixing iron ore together with coke and heated in a blast furnace, molten iron or pig iron is formed. And this pig iron together with other minerals are heated to transformed into steel. Two different processes those are used to transform iron ore together with minerals into steel are 'the blast furnace / basic oxygen furnace (BOF) route' and 'the electric arc furnace route' (EAF).

Primary Steel making:

Blast furnace steel making

In blast furnace iron ore are melted at very high temperature together with coke in the presence of oxygen. At those temperatures, the iron ore releases its oxygen, which is carried away by the carbon from the coke in the form of carbon dioxide A small amount of carbon bonds with the iron, forming pig iron, which is an intermediary before steel

Basic oxygen steel making is a process of primary steel making in which carbon rich pig iron is melted and converted in to steel.

Electric arc furnace steel making is a process of manufacturing of steel from scrap or direct reduced iron melted by electric arcs.

Secondary steel making:

Secondary steel making is most commonly performed in ladles. Some of the operations performed in ladles includes de-oxidation (or 'Killing'), vacuum degassing, alloy addition, inclusion removal, inclusion chemistry modification, de-sulphurisation and homogenization.

2.2. Types of Steel:

There are four main types of steel.

1. Carbon steel

2. Alloy Steel
3. Tool Steel
4. Stainless steel.

2.3. The Elements used in steel :

Carbon (C) : Carbon is chemical element with symbol C and atomic number is 6. Carbon can be found in coal, lime stone, marble. Carbon works as strengthening or hardening agent in steel.

Manganese (Mn): Manganese is chemical element with symbol Mn and atomic number is 25. Manganese can be found in minerals such as Manganite, purpurite, Rhodonite. Manganese is used in steel to remove Oxygen and sulphur and to decrease brittleness of steel.

Phosphorus (P) : Phosphorus is chemical element with symbol Mn and atomic number is 15. Phosphorus can be found in sedimentary rock containing the calcium phosphate mineral apatite. Phosphorus is used in steel to increase resistance to corrosion and improve machinability.

Sulfur (S) : Sulfur is chemical element with symbol Mn and atomic number is 16. Sulfur most common found in anhydrite (calcium sulfate), barite (barium sulfate), chalcocite (copper sulfide). Addition of Sulphur in steel from 0.10% to 0.30 will tend to improve the machinability.

Nickel (Ni) : Nickel is chemical element with symbol Ni and atomic number is 28. Nickel can be found in the iron ore limonite which contains 1~2 %nickel. Also in Pentlandite and garnierite. Nickel in steel increases its properties such as formability, weldability and ductility. Also increase corrosion resistance.

Chromium (Cr) : Chromium is chemical element with symbol Ni and atomic number is 24. Chromium can be found in chromium-bearing mineral is chromite. Chromium strongly increases the hardenability of steel.

The Element of Steel Composition (percentage by mass) examples

<u>Cast Iron:</u> Carbon 2.5 -4.0%, Silicon 1.0 ~ 3.0%, Manganese 0.2~1.0, Sulfur 0.02 ~0.25%, Phosphorus 0.02~1.0%

<u>Low carbon Steel:</u> Typical composition of low carbon steel A36 : Carbon 0.25%, Manganese 1.03%, Phosphorus 0.04%, Silicon 0.28%

<u>Medium carbon steel:</u> Typical composition of medium carbon steel 1040 : Carbon 0.4%, Manganese 0.9%, Phosphorus <0.04%, Sulfur <0.05%

<u>High carbon steel:</u> Typical composition of high carbon steel 1095 : Carbon 0.95%, Manganese 0.5%, Phosphorus <0.04%, Sulfur <0.05%

2.4 Example of Alloy steel grade

For analysis purpose EN24 steel grade is selected.
EN24 Specification Chemical composition is as follow
Carbon : 0.36 ~0.44%
Silicon : 0.10~0.35%
Molybdenum : 0.20 ~0.35%
Nickel : 1.30 ~1.70%
Chromium : 1.00~1.40%
Molybdenum : 0.20 ~0.35%
Nickel : 1.30 ~1.70%
Manganese : 0.45 ~ 0.70%
Sulphur : 0.04 max
Phosphorus : 0.035 max
Chromium : 1.00~1.40%

2.5 Price variation model:

Price variation model build on below considerations.

Referring to section 2.4, major chemical compositions in EN24 steel are Scrap, Nickel, Molybdenum and Chromium. So these are selected for price variation model.

Table -1: Commodities, percentage in model and metal index

Composition	Percentage	Metal Index used
Scrap	110%	Ferrous scrap Rotterdam export shredded \$ per tonne fob Rotterdam
Nickel	1.55%	Nickel Settlement LME Daily Official \$ per tonne
Molybdenum	0.275%	Molybdenum Canned molybdic oxide United States Free market \$ per lb Mo in warehouse
Chromium	1.15%	Ferro-chrome 0.10%C - 62% min Cr United States Free market low carbon duty paid fob Pittsburgh \$ per lb Cr

- In addition to above currency factor also used in model since most of scrap and ferro alloys are imported in India.

- Quarterly prices mentioned in calculations are average price of respective quarter.
- While calculating surcharge for present quarter, price difference between last 2 quarters are taken.
- Prices of all commodities mentioned in Table-1 are converted into INR per tonne before multiplying with individual factor mentioned in table-1.
- Period considered for analysis from year 2016 to 2020.
- Example of price calculation model as given below

Table-2: Pricing model,

Commodities	Sep-15	Dec-15	Mar-16	Jun-16	Sep-16	Dec-16	Mar-17
Scrap	268	218	181	190	262	216	245
Nickel	13000	10592	9,499	8,508	8,779	10,175	10825
Moly	7.8	6.1	5.1	5.55	6.91	7.2	6.93
Crome	2.11	2.09	2.08	1.99	1.89	1.84	1.89
USD to INR	63.47	64.86	65.9	67.5	66.9	67.1	67.34
Commodities	**Q3 2015**	**Q4 2015**	**2016 Q1**	**2016 Q2**	**2016 Q3**	**2016 Q4**	**2017 Q1**
Scrap	17,010	14,139	11,930	12,823	17,515	14,483	16,498
Nickel	825,110	686,997	626,079	574,205	586,876	682,234	728,956
Moly	495	396	336	375	462	483	467
Crome	134	136	137	134	126	123	127
USD to INR							
Price diff	**Q3 2015**	**Q4 2015**	**2016 Q1**	**2016 Q2**	**2016 Q3**	**2016 Q4**	**2017 Q1**
Scrap			- 2,870	- 2,210	893	4,692	-3,032
Nickel			- 138,113	- 60,918	- 51,874	12,671	95,358
Moly			- 99	- 60	38	87	21
Crome			2	2	-3	-8	-3
USD to INR							
Scrap	Rs/tonne		- 2,870	- 2,210	893	4,692	- 3,032
Nickel	Rs/tonne		- 138	- 61	- 52	13	95
Moly	Rs/Kg		- 219	- 131	85	192	46
Crome	Rs/Kg		4	3	- 6	- 18	- 7
USD to INR							
EN24 Steel grade							
Scrap	1.1		-3,158	-2,431	983	5,161	-3,335
Nickel	1.55		-2,141	-944	- 804	196	1,478
Moly	0.275		-601	-360	232	529	126
Crome	1.15		41	39	-71	- 201	- 75
USD to INR							
			-5,858	-3,696	341	5,684	-1,806

2.6 Testing of Price variance model

5 years data considered to understand whether there is nullifying effect of increase and decrease of surcharge or surcharge model only helps Steel mill to get right prices from their customer.

Spend analysis and increase and decrease impact calculations done by considering EN24 steel price as INR100,000 per tonne from period of Q4 2015. And further increase or decrease impact spend calculated based on quarterly buying of 10 tonnes.

Figure -1: Increase or decrease impact quarter on quarter.

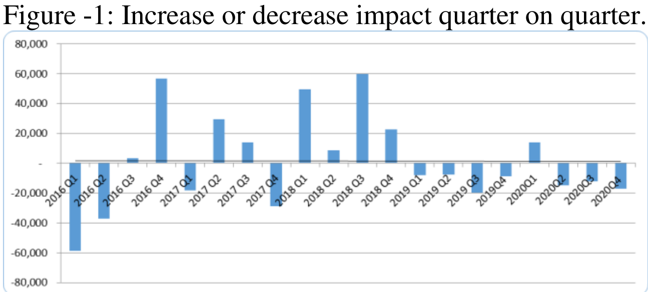
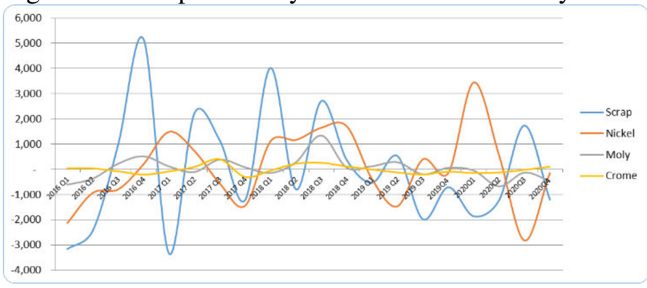


Figure -2 : Scrap and alloy movement over last 5 years



Correlating Figure-2 with Firgure-1, it shows increase or decrease impacts are majorly because of change in scrap and Nickel prices.

Total price impact calculation in terms of value for cumulative period of 2nd year, 3rd year, 4th year and 5th year as below.

Table-3 : Cumulative increased & decreased spend starting from 2016 Q1 till below mentioned period.

2nd Year	3rd Year	4th Year	5th Year
-38812	101,954	57,660	27,756

Further this impact was checked with total spend value for same period. And in terms of percentage, it shows very less impact over total purchased spend.

Figure-3 : Increase / decrease impact w.r.t spend.

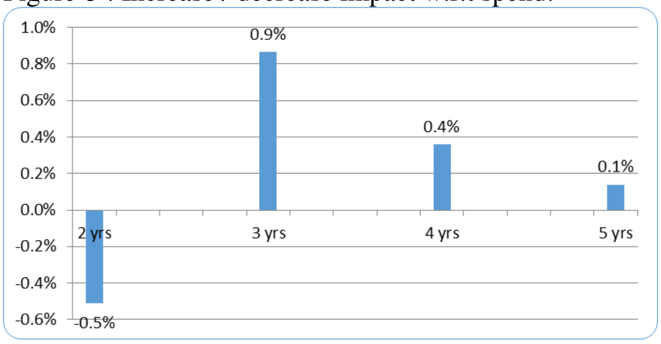


Figure-3 shows, though there is increase impact for 3rd and 4th years, till 5th year price impact get nullified and it shows only 0.1% over total 5 years spend value.

Further investigation was done why full impact of increase and decrease was not realized for same period though scrap and Nickel prices were low during respective periods. So currency rate fluctuation and it's impact was studied.

Figure -4: Currency conversion USD to INR

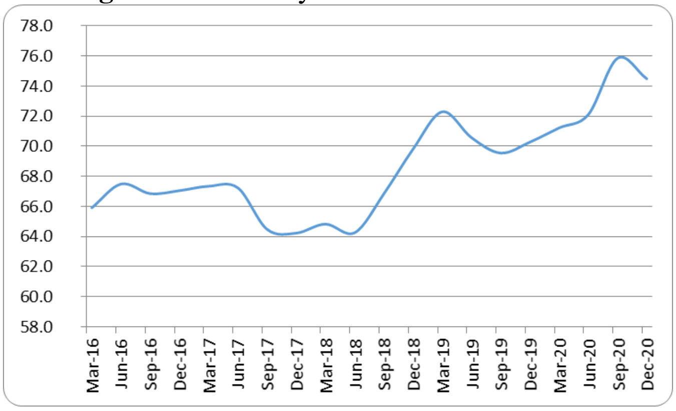


Figure-4 shows that currency had impacted lot to all commodities from June 2018 to Dec 2020 due to increase trend and direct multiplication landed factor taken into price variation model.

Test was conducted to project scenario of price impact, if currency would have been stable for 5 years.

Figure-3 : Forecasted Increase / decrease impact w.r.t spend, with constant currency rate.

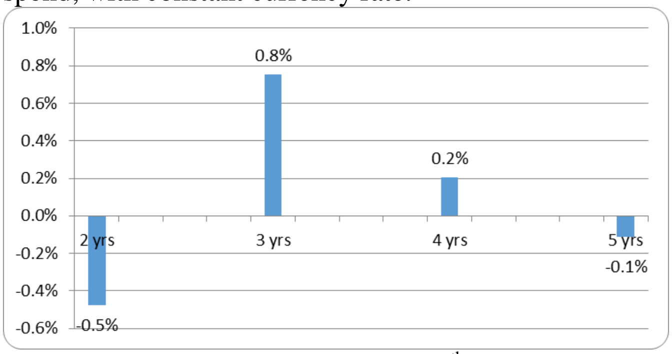


Figure-3 shows decrease impact for 5th years if currency rate is kept constant. i.e. impact in terms of value would have been -22,650 INR till 5th year.

3. CONCLUSIONS

Price variance model formulated to check Scarp and alloy surcharge mechanism for total steel prices, shows positive result at 5th years .i.e. price increase and decrease impact get nullified with this mechanism of Scrap and alloy surcharge model to great extent. Observed some positive / increase impact but main reason behind this is Currency rate of USD to INR for similar period. Though there was decrease impact for some period of time, but due to currency rate change could not recover full impact in calculation. Rolling 5 years cover all seasonality in steel prices.

Result shows that if currency remains stable or has less projected fluctuation for given period then this scrap and alloy surcharge mechanism will help buyer to get maximum benefit. Even currency fluctuate then also recommend to use this model since there are in-tangible benefit of avoiding frequent negotiation and resources involved in negotiation.

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REFERENCES

1. Martin Ekström, Sathish Dhandapani, Samira Allalou : A Guide to Cost Efficient Steel Sourcing. Applied Value LLCRef: COS-1072 November 2008
2. Yasser Elfahham : Estimation and prediction of construction cost index using neural networks, time series, and regression. Alexandria Engineering Journal (2019) 58, 499–506.
3. Secondary Steelmaking Simulation, User Guide, Steel university, World Steel Association.
4. A. G. Malanichev and P. V. Vorob'ev : Forecast of Global Steel Prices. ISSN 1075_7007, Studies on Russian Economic Development, 2011, Vol. 22, No. 3, pp. 304–311

BIOGRAPHIES

Author, Jaideep Gopale working as Deputy General Manager – Sourcing in MNC. Responsible for local and global sourcing. Having industry experience of 2 decades+ (20+ years) with deep knowledge about steel Industry globally.