CHAPTER IV

PROBLEM IDENTIFICATION AND CURRENT SITUATION ANALYSIS

4.1 Problem Identification

According to brain storming about the problem in the production process , the company can be identify into 5 main problem in Man, Machine, Material, Method and Environment as shown in the Figure 4.1

Man

1. Tired due to the high order
2. No preparation time of work
3. Boring from the same work
4. No training the worker

Environment

1. Hot climate
2. A lot of dust

Machine

1. Lost time due to break down maintenance
2. Using a lot time to adjust the machine

Material

1. Substandard of Raw Material
2. Mixing Material at low density
3. Unbalancing chemical element of Raw Material
4. Incorrect adjust recovery of the raw material

Method

1. Wrong Adjustment Voltage Arc
2. Wrong Adjustment Current Arc
3. Wrong addition charging method

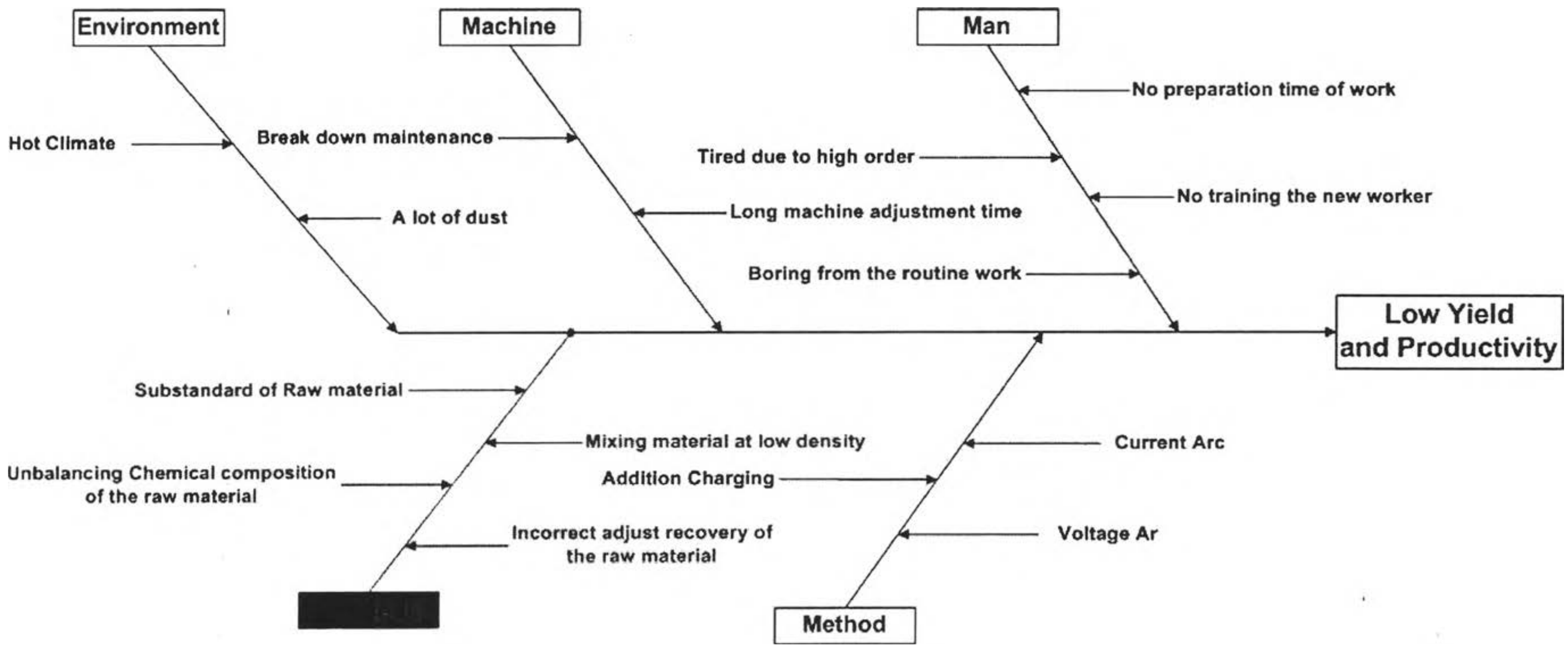

Figure 4.1 Causes and Effect diagram of Low yield and productivity problems

In this thesis, I focus on managing and mixing the raw material especially in the melting process. So the problems about material in the fishbone diagram that relating the Melting process are solved in this case. The detail of the problem due to material can be shown below:

4.2 General information of Material Problems

4.2.1 Substandard of Raw Material

At present, the company have categorizing the raw material into many types following the utilization such as scrap, pig iron, carbon, lime and so on. The main raw material that we have to consider is scrap because the scraps have much steel categorizes that the company receiving within the country. Presently, The company has categorizing the common main scrap into Extra Heavy steel (Po(ex)), Heavy steel (Po), medium steel(A), light steel (B). These categorizing are provided following the density of the scrap. However, although the company have categorizing the scrap, these categorizing are boarded categorizing and the worker are not awareness the importance of categorizing. This lead to the quality of the scrap is poor. The quality of the raw materials has influence to the quality of the product. If the company use the Substandard Raw material, the company has to use the longer time to adjust the elements to meet the requirement. Sometimes, If the worker calculates the balancing of material from the chemical formula and he doesn't think that the quality of the raw material is poor from the standard, this leads to the output of the product being poor from the standard too. And then the products that produced are not meeting the specification requirement. The impact of these is wasting the time, losing the raw material or receiving the second grade of the product.

4.2.2 Mixing Material at low density

Providing the raw material to producing the product is necessary to consider the weight and the volume of the raw material. The weight of the product is one of the specifications of the product so mixing the raw material to receiving the specification is required. However, there is the limitation in volume. It means that meting the raw material has the limiting in size of Electric arc furnace so managing the raw material to charging raw material is important. The raw material that charging in the EAF is called direct raw material. These direct raw materials are the scraps and the pig iron. These direct raw materials are necessary to manage by considering the mass of raw material, the volume of EAF and the bucket, the chemical element and so on. However if we can manage by using minimum the amount of the bucket and meeting the specification requirement, it reducing the time of Power of time. For example, currently the company uses 4 buckets for scraps and pig iron. Tap to tap time of the product MS code 00001can be shown below:

Example Tap To Tap time 83 Min/Heat

1. Power on time 58 Min/Heat
2. Power off time 25 Min/Heat

Power off time separating into

2.1 Scrap Charging time 12 Min/Heat

2.2 Tap time 4 Min/Heat

2.3 Other 9 Min/Heat

2.3.1 Turn Around Furnace

2.3.2 EBT Cleaning & Putting sands and closing time

2.3.3 Slag door cleaning & Putting Raw dolomite to make the blank

If we can reduce the amount of the bucket by meeting the specification requirement, this leads to decrease the Scrap charging time and then lead to improving the productivity. The standard Japanese company that managing the bucket of material in the product MS code 00001at 0.8 densities use only 2 buckets. This certainly leads to reducing the time of charging time approximately 6 minutes and it may be reducing the time of power on time about 4 – 5 minutes. The standard of tap to tap time of the standard company can be shown below:

Example Tap To Tap time 72.2 Min/Heat

1. Power on time 51.19 Min/Heat
2. Power off time 19 Min/Heat
   - 2.1 Scrap Charging time 6 Min/Heat
   - 2.2 Tap time 4 Min/Heat
   - 2.3 Other 9 Min/Heat

So if the company wants to improve the capacity in the same direction of the standard company, the company will have increasing the capacity of production time duce to reducing the tap to tap time in the same direction of the standard company.

4.2.3 Unbalancing chemical element of Raw Material

Each product has the specification in the chemical composition such as the specification of customer requirement or the company specification following the standard. The Raw material that company using in production is necessary to balance to meet the chemical specification. These raw materials that provide to producing each heat unbalance in the chemical element, these impacts on the quality of the product and wasting time to adjust the chemical element for meeting requirement or losing the melting steel defect that pass the next process. The example of this situation in the company can be shown below:

Ex. In producing the product at MS(Molten steel) code 0001, the chemical composition element that require are composed of:

Table 4.1 The MS Code 00001 specification requirement

MS Code	% C	%P	%S	O2 ppm
00001	0.040	0.020	0.020	700-850

At first, the workers have to provide the raw material such scrap, pig iron to receiving the molten steel element are nearly the MS code 00001 as much as possible to reducing the addition.

In the situation that happened, the company blended the scrap and pig iron into the bucket according to the table 4.1 standard. The output after melting should be composed of % C = 0.8%, %P = 0.025%, and %S = 0.040% and then the company used Cao to eliminate the percent of P and S that is over from the specification about 15 tons. However, in that situation, the molten steel that providing following to the table 1 standard consisted of %c = 0.85%,%P =0.035%, and %S = 0.045%. The percent of P and S are quite difference from the standard specification. These leads to the company use the CaO increasing to eliminate that element by using approximately 20 tons. This impacts to the increasing of raw material cost (Increasing CaO 5 tons) and the time increasing to add and melting increasing CaO.

4.2.4 Incorrect adjustment recovery of the raw material

In providing the scrap, pig iron and so on to receiving the molten steel specification requirement, there are many directions to providing them to receiving the nearest specification requirement. However, each direction of scrap providing causes the chemical composition of output is different. Each chemical composition output has the difference of ability in absorbing addition.

Ex. In the situation happened, the output of melting the blending of the scrap and pig iron are composed of %C = 0.8%, %P = 0.03, %S = 0.025% at 149.5 tons. This output has to adjust the element of the output to receiving the specification by addition Ferro Manganese. Additional Ferro Manganese from calculation should be use 80 kg but actually Ferro manganese has to use 100 kg to do the chemical reaction at 80 kg and the other 20 kg may be lose due to chemical reaction or absorbed by slag. At this time, the company doesn't consider the recovery of addition material in adjustment to receiving specification. So the company loses from addition incorrect the quantity of addition material. This lead to receiving the low quality of the product and this product is sold at the lower grade of the product.

4.3 Current situation Analysis

4.3.1 Analyze basket pattern and EAF procedure

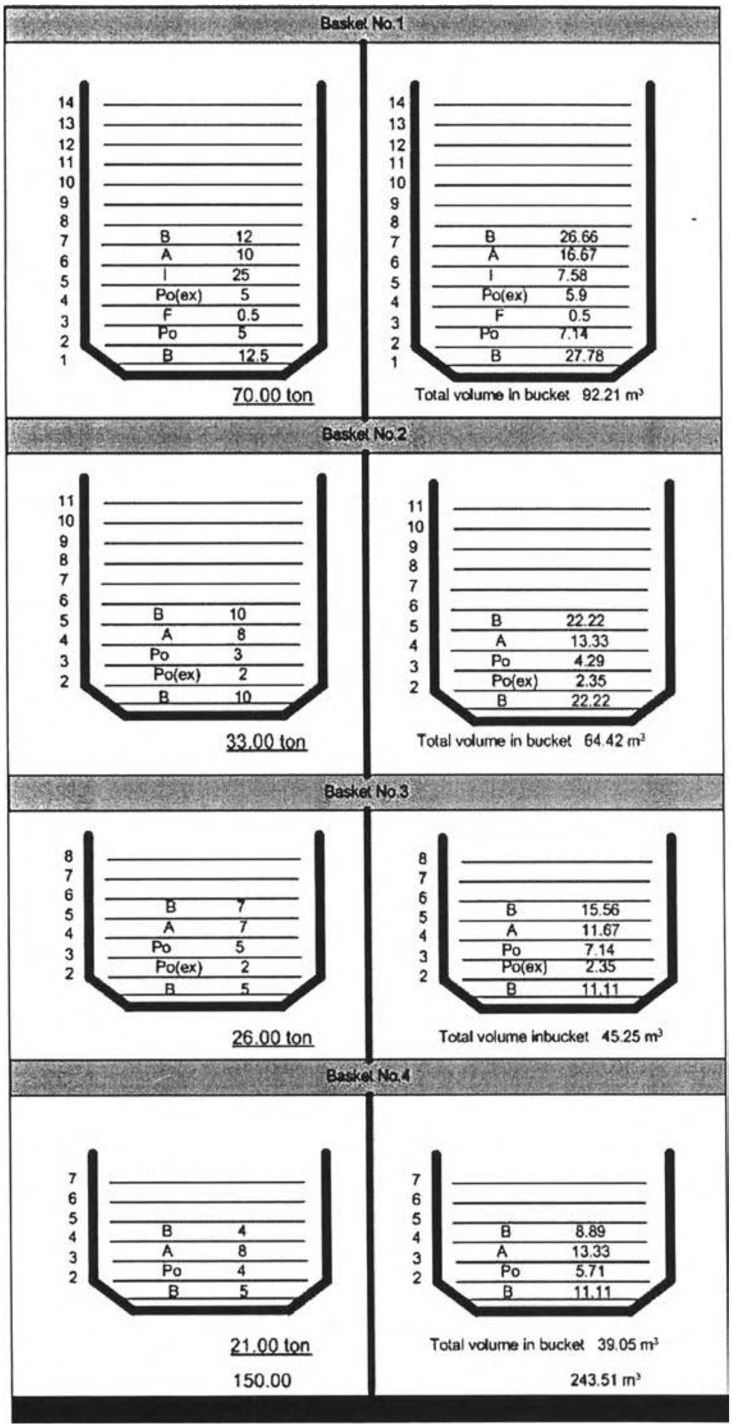

Figure 4.2 The 4-basket pattern

The furnace materials are charged to EAF by following to the charge table. In the charge table, It contain the type and quantity of the furnace material (i.e. Scrap, Pig Iron, flux). However, in practice, the scrap preparation worker handles the furnace material by following the basket pattern that contains in the charge table form

At first, the scrap preparation workers prepare the basket by checking the MS Code from the basket pattern and then handle the scrap into the basket following the bucket pattern.

After the scrap preparation workers handle the scrap and the other raw materials into the basket that there are 4 baskets per 1 heat. And then these raw materials (i.e. Scrap, Pig Iron, Flux, etc) from the scrap baskets are charge to the furnace by EAF crane. The level 2 computer retains the full process history record of heat at the EAF and this allows the LHF to verify the current actual chemistry against the MS Grand Code requirement. The EAF procedure of 4-baskets pattern can be shown in the Figure 4.3

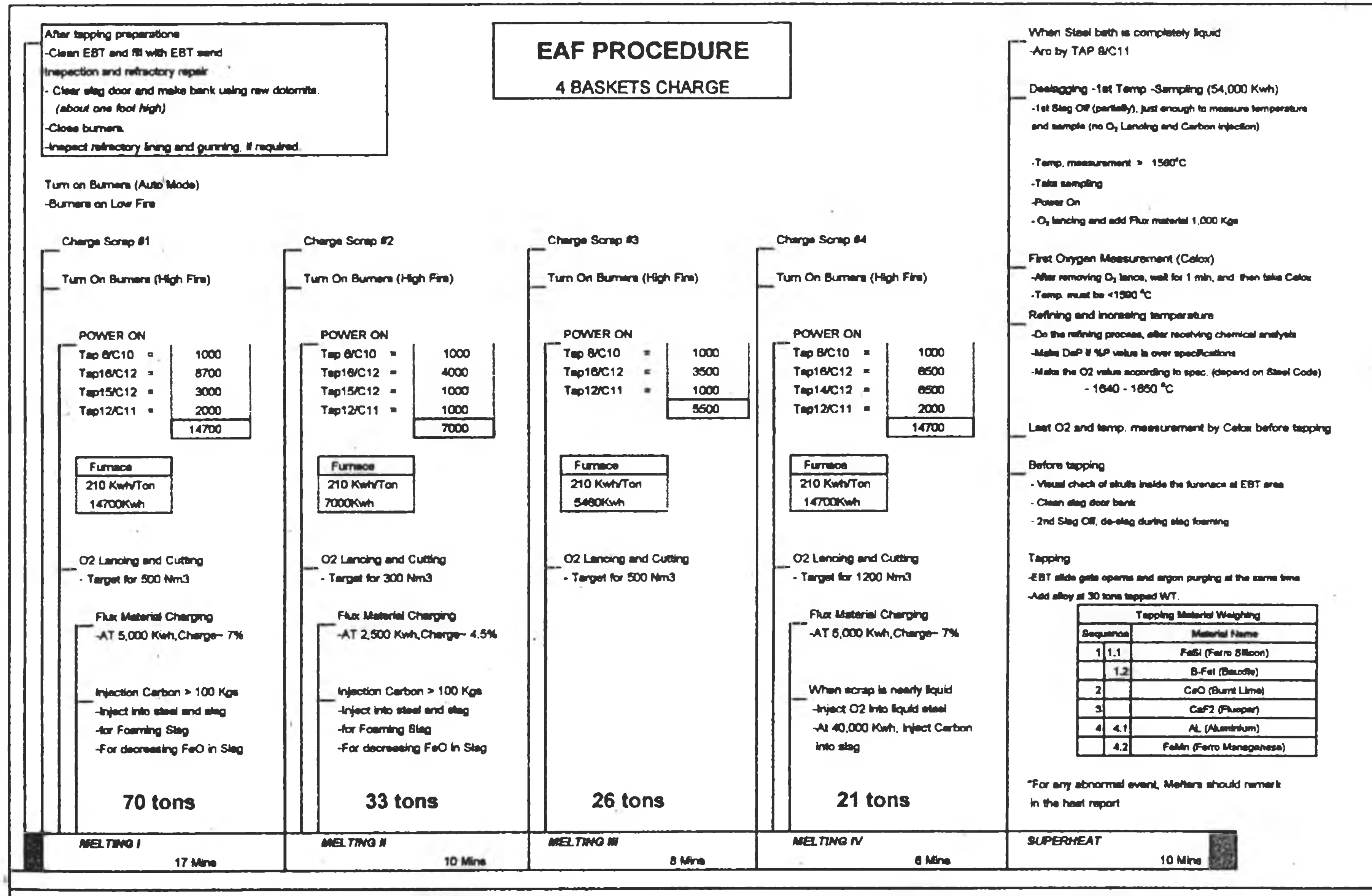

Figure 4.3 The EAF procedure of 4-baskets pattern

4.3.2 Data of mixing scrap and chemical composition

From the record, I analyze the data by separating into heat, day, and month as shown in the table below:

Table 4.2 The example of managing scrap in each basket

Scrap type	*Basket 1*		*Basket 2*		*Basket 3*		*Basket 4*		*Total*	
	(tons)	*m3*	*(tons)*	*m3*	*(tons)*	*m3*	*(tons)*	*m3*	*(tons)*	*m3*
Po(ex)	5.00	5.88	2.00	2.35	2.00	2.35	-	-	9.00	10.59
Po	5.00	7.14	3.00	4.29	5.00	7.14	4.00	5.71	17.00	24.29
A	10.00	16.67	8.00	13.33	7.00	11.67	8.00	13.33	33.00	55.00
B	24.50	54.44	20.00	44.44	12.00	26.67	9.00	20.00	65.50	145.56
I	25.00	7.58	-	-	-	-	-	-	25.00	7.58
F	0.50	0.50	-	-	-	-	-	-	0.50	0.50
Total	70.00	92.21	33.00	64.42	26.00	47.83	21.00	39.05	150.00	243.51
Density	0.759		0.512		0.544		0.538		0.616	

Table 4.3 The example chemical composition received from melting scrap 4-basket pattern in each heat

Matallic Input	*Unit*	*Po(ex)*	*Po*	*A*	*B*	*I (PigIron)*	*Scrap Mix*	*Scrap Mix (tons)*	*Flux*
Input Ratio	%	6.020	11.371	22.074	43.813	16.722	100.000	149.500	0.500
C	%	0.200	0.200	0.150	0.120	3.300	0.672	1.005	-
P	%	0.025	0.020	0.000	0.015	0.150	0.035	0.053	-
S	%	0.025	0.020	0.015	0.015	0.050	0.022	0.033	-
Mn	%	1.000	0.800	0.015	0.050	1.000	0.344	0.514	-
Si	%	0.250	0.200	0.060	0.120	1.250	0.313	0.467	-
Weight	tons	9.00	17.00	33.00	65.50	25.00	149.50		0.50
Total							150.00		

In the table 4.2 and table 4.3, they demonstrate the mixing the scrap of the company by mixing 4-basket pattern and the chemical composition received after melting these scrap. In the basket 1, there are composed of pig iron, Po(ex), Po, A and B about 70 tons at the volume about 92.21 m^3. So the density of the first basket is about 0.759 ton/m^3. And the second basket consists of Po(ex), Po, A, and B. The quantity of Po(ex), Po, A and B in the second basket is 2, 3, 8 and 20 tons respectively. The density of the second basket is about 0.512 ton/m^3. And the density of the third basket and fourth basket is equal to 0.544 and 0.538 respectively. So the total density received from the mixing all four baskets is about 0.616. According to mixing the scrap from this pattern, the quantity of chemical composition received each heat is about carbon 1.005 tons (0.672 percent), phosphorous 0.053 tons (0.035 percent), Sulfur 0.033 tons (0.022 percent), manganese 0.514 tons (0.344 percent) and silicon 0.467 tons (0.313 percent)

Table 4.4 The example quantity of scrap mixing each day.

Scrap type	*Bulk density (tons/m^3)*	*Scrap Mix*								*Total*
		1st heat	*2nd heat*	*3rd heat*	*4th heat*	*5th heat*	*6th heat*	*7th heat*	*8th heat*	
Pig Iron	3.30	25.00	25.00	25.00	24.95	24.98	25.00	24.99	24.95	199.87
Po(ex)	0.85	9.00	8.95	9.02	9.02	9.00	9.02	8.98	9.00	71.99
Po	0.70	17.00	17.02	17.05	17.03	17.05	17.02	16.98	17.05	136.20
A	0.60	33.00	33.01	33.03	32.98	32.95	33.05	33.03	32.95	264.00
B	0.45	65.50	65.54	65.52	65.53	65.52	65.55	65.54	65.53	524.23
Flux	1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	4.00
Total(tons)		150.00	150.02	150.12	150.01	150.00	150.14	150.02	149.98	1200.29
Volume (m3)		243.51	243.58	243.69	243.59	243.53	243.75	243.59	243.54	1944.79
Avg Density		0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62

In table 4.4, it demonstrates the mixing the scrap in each day. The working day has the working time about 11 hours and the holiday or festival day has the working time 24 hours. So ,in the working day, the company can run melting the scrap 8 heat per day and 17 heat per day in the holiday or the festival day (Tap to tap time is about 83 minutes). Table 4.4 is the example of quantity of utilizing each scrap type in each day for working day (having 8 heats) by following the mixing in each heat as shown in the table 4.2. According to the table 4.4, the utilization of scrap is about 150 tons at 243.51 m^3 each heat so the quantity of scrap used is about 1200 tons at 1945 m^3. The average density of each day is about 0.62 ton/m^3.

Table 4.5 The example chemical composition received from melting scrap 2-basket pattern in each day

Heat No.	*C*		*P*		*S*		*Mn*		*Si*	
	(Kgs)	*(%)*	*(Kgs)*	*(%)*	*(Kgs)*	*(%)*	*(Kgs)*	*(%)*	*(Kgs)*	*(%)*
1st Heat	1005.100	0.672	52.975	0.035	32.925	0.022	513.700	0.344	467.400	0.313
2nd Heat	1004.774	0.672	52.332	0.035	32.894	0.022	514.349	0.344	467.998	0.313
3rd Heat	1005.446	0.672	52.367	0.035	32.916	0.022	514.693	0.344	468.311	0.313
4th Heat	1004.707	0.672	52.329	0.035	32.892	0.022	514.314	0.344	467.966	0.313
5th Heat	1004.640	0.672	52.325	0.035	32.890	0.022	514.280	0.344	467.935	0.313
6th Heat	1005.581	0.672	52.374	0.035	32.921	0.022	514.762	0.344	468.373	0.313
7th Heat	1004.774	0.672	52.332	0.035	32.894	0.022	514.349	0.344	467.998	0.313
8th Heat	1004.506	0.672	52.318	0.035	32.886	0.022	514.211	0.344	467.872	0.313
Total	8039.529	0.670	419.352	0.035	263.219	0.022	4114.658	0.343	3743.853	0.312

Table 4.5 demonstrates the example chemical composition received of melting the scrap following table 4.4. The quantity of carbon, phosphorous, sulfur, manganese, silicon received is equal to 8039, 419, 263, 4114, 3744 tons respectively. If all of these quantity compare with the total scrap used to be the percentage, it is equal to 0.67, 0.035, 0.022, 0.343, 0.312 respectively.

Table 4.6 The production report of EAF1 in (1-31 November, 2003)

Raw Material Report Production Date 1-30 November 2002 EAF 1

Date	*Pig Iron (tons)*	*Po (ex) (tons)*	*Po (tons)*	*A (tons)*	*B (tons)*	*Flux (tons)*	*Total (tons)*	*Volume (m^3)*	*Density (t/m^3)*	*Production (tons)*	*Yield (%)*	*Pro.Time (mins/day))*	*T-T-T (mins)*
1/11/02	199.87	71.99	136.20	264.00	524.23	4.00	1200.29	1948.79	0.62	912.22	75.00	660	82.5
2/11/02	424.72	152.79	289.43	561.00	1113.99	8.50	2550.43	4140.95	0.62	1938.32	76.00	1411	83
3/11/02	424.71	152.78	289.42	561.10	1113.98	8.50	2550.49	4141.08	0.62	1938.37	76.00	1414.4	83.2
4/11/02	199.87	71.90	136.21	264.02	524.23	4.00	1200.23	1948.73	0.62	900.17	75.00	657.6	82.2
5/11/02	199.88	71.90	136.19	264.03	524.20	4.00	1200.20	1948.65	0.62	864.14	72.00	658.4	82.3
6/11/02	199.87	71.89	136.2	264.01	524.23	4.00	1200.20	1948.69	0.62	900.15	75.00	656.8	82.1
7/11/02	199.89	71.90	136.2	264.02	524.21	4.00	1200.22	1948.68	0.62	864.16	72.00	660	82.5
8/11/02	199.89	71.90	136.18	264.03	524.23	4.00	1200.23	1948.71	0.62	900.17	75.00	656.8	82.1
9/11/02	424.72	152.78	289.42	561.05	1113.95	8.50	2550.42	4140.93	0.62	1963.82	77.00	1394	82
10/11/02	424.72	152.79	289.41	561.03	1114.00	8.50	2550.45	4141.00	0.62	1989.35	78.00	1394	82
11/11/02	199.88	72.00	136.2	264.02	524.23	4.00	1200.33	1948.84	0.62	900.25	75.00	659.2	82.4
12/11/02	199.89	71.95	136.22	264.00	524.22	4.00	1200.28	1948.75	0.62	912.21	76.00	658.4	82.3

57

Table 4.6 The production report of EAF1 in (1-31 November, 2003) Cont.

Raw Material Report Production Date 1-30 November 2002 EAF 1

Date	Pig Iron (tons)	Po (ex) (tons)	Po (tons)	A (tons)	B (tons)	Flux (tons)	Total (tons)	Volume (m^3)	Density (t/m^3)	Production (tons)	Yield (%)	Pro.Time (mins/day))	T-T-T (mins)
13/11/02	199.89	71.95	136.22	264.00	524.22	4.00	1200.28	1948.75	0.62	888.21	74.00	659.2	82.4
14/11/02	199.87	71.93	136.2	264.00	524.23	4.00	1200.23	1948.72	0.62	912.17	76.00	657.6	82.2
15/11/02	199.87	71.93	136.2	264.02	524.20	4.00	1200.22	1948.68	0.62	912.17	76.00	656.8	82.1
16/11/02	424.72	152.79	289.43	561.00	1113.99	8.50	2550.43	4140.95	0.62	1938.32	76.00	1395.7	82.1
17/11/02	424.71	152.78	289.42	561.10	1113.98	8.50	2550.49	4141.08	0.62	1938.37	76.00	1394	82
18/11/02	199.87	71.92	136.22	264.02	524.22	4.00	1200.25	1948.75	0.62	912.19	76.00	656.8	82.1
19/11/02	199.87	71.92	136.21	264.00	524.23	4.00	1200.23	1948.72	0.62	912.17	76.00	656	82
20/11/02	199.89	71.91	136.23	264.02	524.21	4.00	1200.26	1948.73	0.62	912.20	75.00	656	82
21/11/02	199.87	71.90	136.21	264.00	524.22	4.00	1200.20	1948.67	0.62	912.15	76.00	656.8	82.1
22/11/02	199.87	71.90	136.2	264.02	524.22	4.00	1200.21	1948.69	0.62	912.16	76.00	657.6	82.2
23/11/02	424.72	152.78	289.42	561.05	1113.95	8.50	2550.42	4140.93	0.62	1938.32	76.00	1395.7	82.1
24/11/02	424.72	152.79	289.43	561.00	1113.99	8.50	2550.43	4140.95	0.62	1887.31	74.00	1402.5	82.5

58

Table 4.6 The production report of EAF1 in (1-31 November, 2003) Cont.

Raw Material Report Production Date 1-30 November 2002 EAF 1

Date	Pig Iron (tons)	Po (ex) (tons)	Po (tons)	A (tons)	B (tons)	Flux (tons)	Total (tons)	Volume (m^3)	Density (t/m^3)	Production (tons)	Yield (%)	Pro.Time (mins/day))	T-T-T (mins)
25/11/02	199.87	71.92	136.2	264.02	524.22	4.00	1200.23	1948.72	0.62	900.17	75.00	658.4	82.3
26/11/02	199.87	71.92	136.23	264.00	524.20	4.00	1200.22	1948.68	0.62	912.17	76.00	656	82
27/11/02	199.88	71.92	136.2	264.03	524.20	4.00	1200.23	1948.69	0.62	900.17	75.00	657.6	82.2
28/11/02	199.87	71.92	136.22	263.98	524.20	4.00	1200.19	1948.63	0.62	912.14	76.00	656.8	82.1
29/11/02	199.87	71.92	136.22	263.97	524.23	4.00	1200.21	1948.68	0.62	900.16	75.00	656.8	82.1
30/11/02	424.72	152.78	289.42	561.05	1113.95	8.50	2550.42	4140.93	0.62	1989.33	75.00	1394	82
Total	8019.87	2885.44	5465.1	10593.59	21034.36	160.50	48158.91	78191.75	0.62	36473.24	75.74	26404.9	82.11875

59

Table 4.7 The production report of EAF1 in (1-30 December, 2003)

Raw Material Report   Production Date   1-30 December 2002   EAF1

Date	*Pig Iron (tons)*	*Po (ex) (tons)*	*Po (tons)*	*A (tons)*	*B (tons)*	*Flux (tons)*	*Total (tons)*	*Volume (m^3)*	*Density (t/m^3)*	*Production (tons)*	*Yield (%)*	*Pro.Time (mins/day))*	*T-T-T (mins)*
1/12/02	424.73	152.78	289.42	561.01	1113.96	8.50	2550.40	4140.89	0.62	1989.31	75.00	1394	82
2/12/02	199.87	71.92	136.22	264	524.2	4	1200.21	1948.67	0.62	900.16	75.00	656	82
3/12/02	199.87	71.9	136.2	264.03	524.23	4	1200.23	1948.73	0.62	900.17	75.00	656	82
4/12/02	199.87	71.9	136.2	264.01	524.22	4	1200.20	1948.68	0.62	888.15	74.00	659.2	82.4
5/12/02	199.88	71.9	136.21	264.02	524.23	4	1200.24	1948.73	0.62	864.17	72.00	660	82.5
6/12/02	424.72	152.76	289.42	561.01	1113.96	8.5	2550.37	4140.86	0.62	1861.77	73.00	1399.1	82.3
7/12/02	424.71	152.78	289.41	561	1113.97	8.5	2550.37	4140.87	0.62	1912.78	75.00	1397.4	82.2
8/12/02	199.87	71.9	136.2	264.01	524.23	4	1200.21	1948.70	0.62	876.15	73.00	659.2	82.4
9/12/02	199.87	71.9	136.2	264.01	524.23	4	1200.21	1948.70	0.62	870.15	72.50	660	82.5
10/12/02	199.87	71.92	136.21	264.03	524.23	4	1200.26	1948.77	0.62	876.19	73.00	659.2	82.4
11/12/02	199.88	71.92	136.2	264.02	524.21	4	1200.23	1948.70	0.62	888.17	74.00	658.4	82.3

60

Table 4.7 The production report of EAF1 in (1-30 December, 2003) Cont.

Raw Material Report Production Date 1-30 December 2002 EAF1

Date	Pig Iron (tons)	Po (ex) (tons)	Po (tons)	A (tons)	B (tons)	Flux (tons)	Total (tons)	Volume (m^3)	Density (t/m^3)	Production (tons)	Yield (%)	Pro.Time (mins/day))	T-T-T (mins)
12/12/02	199.87	71.95	136.23	264.02	524.2	4	1200.27	1948.75	0.62	912.21	76.00	656.8	82.1
13/12/02	424.73	152.77	289.41	561.01	1113.98	8.5	2550.40	4140.91	0.62	1963.81	77.00	1395.7	82.1
14/12/02	424.74	152.78	289.4	561.01	1113.98	8.5	2550.41	4140.91	0.62	1912.81	75.00	1397.4	82.2
15/12/02	199.87	71.9	136.2	264.02	524.23	4	1200.22	1948.72	0.62	888.16	74.00	658.4	82.3
16/12/02	199.87	71.9	136.2	264	524.22	4	1200.19	1948.66	0.62	876.14	73.00	658.4	82.3
17/12/02	199.87	71.9	136.19	264.02	524.2	4	1200.18	1948.63	0.62	900.14	75.00	657.6	82.2
18/12/02	199.88	71.9	136.19	264.02	524.22	4	1200.21	1948.68	0.62	888.16	74.00	659.2	82.4
19/12/02	199.88	71.92	136.2	263.95	524.23	4	1200.18	1948.63	0.62	912.14	76.00	656.8	82.1
20/12/02	424.72	152.77	289.41	561.02	1113.98	8.5	2550.40	4140.92	0.62	1912.80	75.00	1397.4	82.2
21/12/02	424.71	152.78	289.42	561	1113.97	8.5	2550.38	4140.89	0.62	1963.79	77.00	1394	82
22/12/02	199.88	71.92	136.2	264.01	524.22	4	1200.23	1948.70	0.62	912.17	76.00	656.8	82.1
23/12/02	199.87	71.92	136.18	264	524.21	4	1200.18	1948.63	0.62	876.13	73.00	659.2	82.4

Table 4.7 The production report of EAF1 in (1-30 December, 2003) Cont.

Raw Material Report Production Date 1-30 December 2002 EAF1

Date	*Pig Iron (tons)*	*Po (ex) (tons)*	*Po (tons)*	*A (tons)*	*B (tons)*	*Flux (tons)*	*Total (tons)*	*Volume (m^3)*	*Density (t/m^3)*	*Production (tons)*	*Yield (%)*	*Pro.Time (mins/day))*	*T-T-T (mins)*
24/12/02	199.87	71.91	136.18	264.02	524.21	4	1200.19	1948.65	0.62	900.14	75.00	658.4	82.3
25/12/02	199.87	71.91	136.19	263.98	524.23	4	1200.18	1948.65	0.62	888.13	74.00	659.2	82.4
26/12/02	199.88	71.9	136.2	263.98	524.23	4	1200.19	1948.65	0.62	912.14	76.00	656.8	82.1
27/12/02	424.71	152.78	289.42	561.01	1113.97	8.5	2550.39	4140.90	0.62	1861.78	73.00	1402.5	82.5
28/12/02	424.71	152.76	289.42	561.01	1113.97	8.5	2550.37	4140.88	0.62	1938.28	76.00	1395.7	82.1
29/12/02	199.87	71.92	136.2	264.02	524.22	4	1200.23	1948.72	0.62	888.17	74.00	658.4	82.3
30/12/02	424.72	152.77	289.42	561.01	1113.98	8.5	2550.40	4140.92	0.62	1938.30	76.00	1395.7	82.1
Total	8244.66	2965.9	5618.2	10890.3	21624.1	165	49508.13	80217.68	0.62	37072.58435	74.88	27132.9	82.2209091

62

Table 4.6 and table 4.7 demonstrate the utilization of scrap in November and December respectively. The average quantity of using scrap is about 1212.2 tons per day on the working day and 3451 tons per day on the holiday. In addition, they show the density, production, yield, production time, and T-T-T time. According to these data, they can be plotted to the graph in figure 4.4-4.6

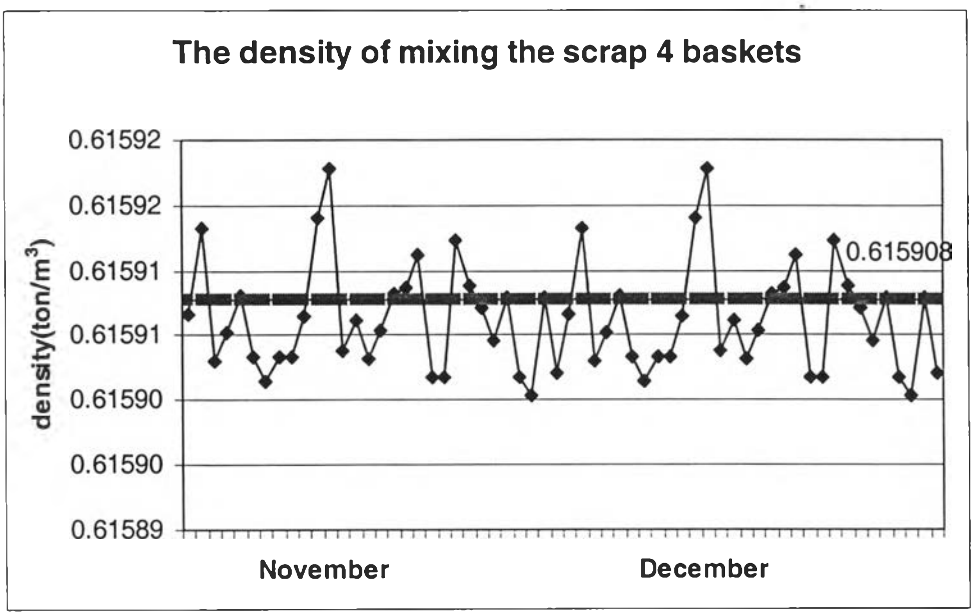

Figure 4.4 The density of mixing the scrap 4 baskets

In November and December, the scrap preparing worker provides the scrap to the basket at the 0.65 ton/m^3. However, this density is not suitable for saving energy for melting the scrap. The density that saving energy for melting scrap are about 0.8-0.9 ton/m^3. So the company should provide the scrap to be at that density to saving the energy for melting that it means reducing the cost of the using energy.

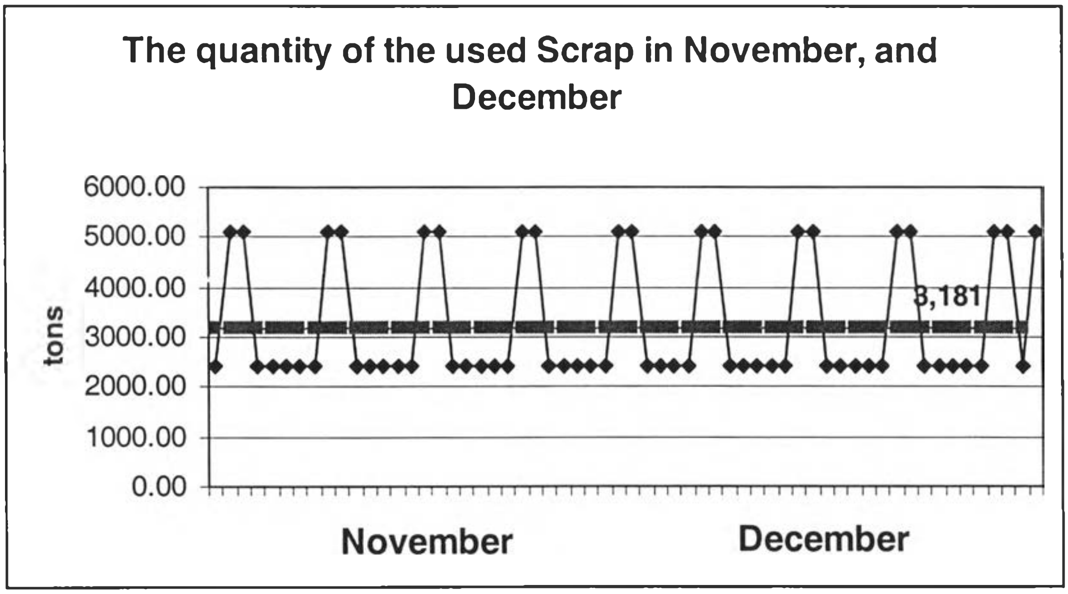

Figure 4.5 the quantity of the used scrap in November, and December

In the figure 4.5, it shows the utilization of the scrap each day in November and December by collecting the data from the table 4.6 and 4.7. As you can see in the graph, the average quantity of scrap utilization is about 2,400 tons per day on the working day and 5,100 tons per day on the holiday and festival day.

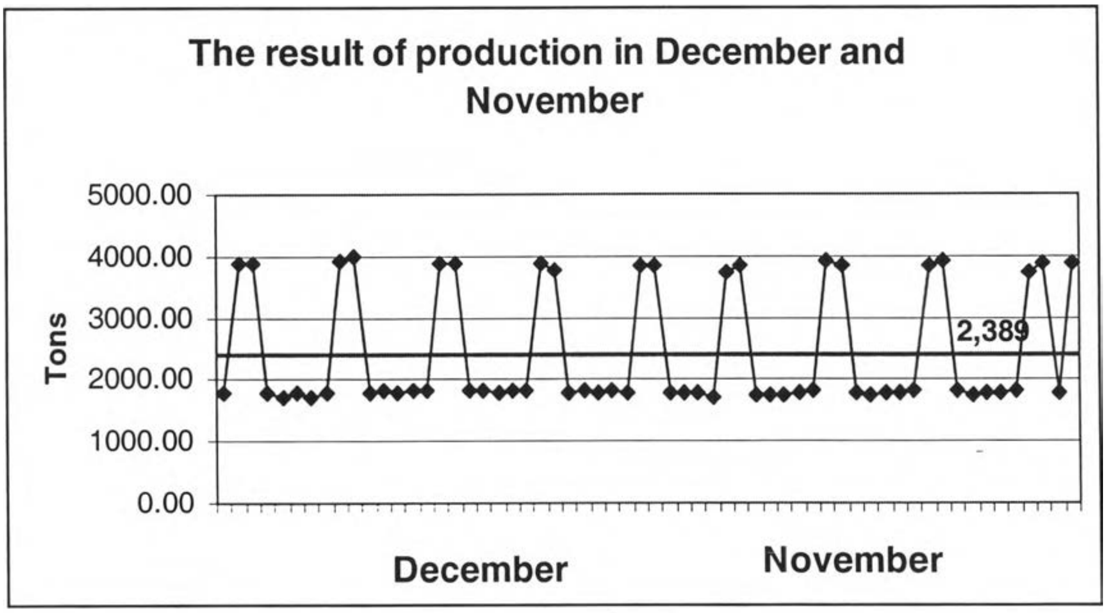

Figure 4.6 the result of production in December and November

According to the figure 4.5, the company uses the scrap about 2,400 tons per day on the working day and 5,100 tons per day on the holiday and festival day. After passing the production process, it can produce the product about 1,800 tons per day on the working day and 3,800 tons per day on the holiday and festival day. The average productions of two month are about 1055 tons per day. According to these data, they can be taken to calculate the yield received from this formula.

$$Yield = \frac{Output(production)}{Input(Scrap\ used)} x100$$

Following this formula, the yield of the company in November and December can be plotted into Figure 4.7

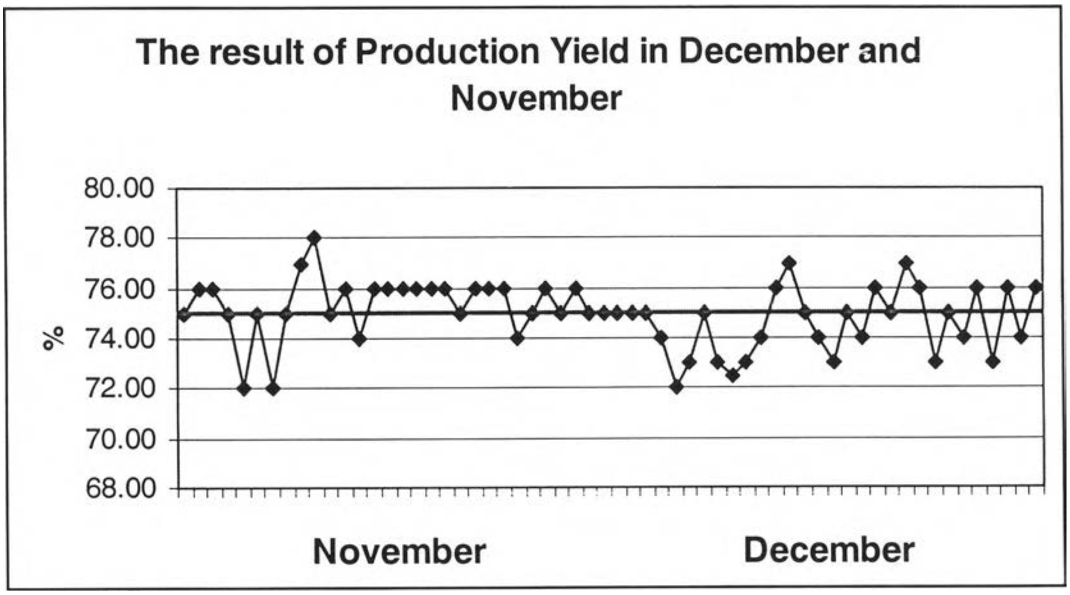

Figure 4.7 The result of Production yield in December and November

In the Figure 4.7, it shows that Yield of the company is between 78%-72% and the average of these yield values are 75%. The yield of the company are not constant due to the problem discuss above so if the company would like yield of the company increasing and constant. The company should solve those problems.

By the way, from using the scrap in Tables 4.6-4.7, the chemical compositions are received from melting process can be shown in Tables 4.8-4.9

Table 4.8 The chemical compositions received after passing the melting process in November

Date	C		P		S		Mn		Si	
	tons	%	tons	%	tons	%	tons	%	tons	%
1/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.110	0.344	3.738	0.312
2/11/2002	17.079	0.672	0.900	0.035	0.560	0.022	8.732	0.344	7.943	0.312
3/11/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
4/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
5/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
6/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.343	3.738	0.312
7/11/2002	8.038	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.313
8/11/2002	8.038	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.313
9/11/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
10/11/2002	17.079	0.672	0.900	0.035	0.560	0.022	8.732	0.343	7.943	0.312
11/11/2002	8.038	0.672	0.424	0.035	0.263	0.022	4.110	0.344	3.738	0.312
12/11/2002	8.038	0.672	0.424	0.035	0.263	0.022	4.110	0.344	3.738	0.313
13/11/2002	8.038	0.672	0.424	0.035	0.263	0.022	4.110	0.344	3.738	0.313
14/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
15/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
16/11/2002	17.079	0.672	0.900	0.035	0.560	0.022	8.732	0.344	7.943	0.312
17/11/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
18/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
19/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
20/11/2002	8.038	0.672	0.424	0.035	0.263	0.022	4.110	0.344	3.738	0.313
21/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
22/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
23/11/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312

Date	C		P		S		Mn		Si	
	tons	%	tons	%	tons	%	tons	%	tons	%
24/11/2002	17.079	0.672	0.900	0.035	0.560	0.022	8.732	0.344	7.943	0.312
25/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
26/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
27/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
28/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
29/11/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
30/11/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
Total	322.489	0.672	16.999	0.035	10.569	0.022	164.881	0.344	149.990	0.312

Table 4.9 The chemical compositions received after passing the melting process in December

Date	C		P		S		Mn		Si	
	tons	%	tons	%	tons	%	tons	%	tons	%
1/12/2002	17.079	0.672	0.900	0.035	0.560	0.022	8.732	0.344	7.943	0.312
2/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
3/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.343	3.738	0.312
4/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
5/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
6/12/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
7/12/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
8/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
9/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
10/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
11/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
12/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.110	0.344	3.738	0.312
13/12/2002	17.079	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312

Date	C		P		S		Mn		Si	
	tons	*%*	*tons*	*%*	*tons*	*%*	*tons*	*%*	*tons*	*%*
14/12/2002	17.079	0.672	0.900	0.035	0.560	0.022	8.732	0.344	7.943	0.312
15/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
16/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
17/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
18/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
19/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.313
20/12/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
21/12/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.344	7.943	0.312
22/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
23/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
24/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
25/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
26/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.313
27/12/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.344	7.943	0.312
28/12/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
29/12/2002	8.037	0.672	0.424	0.035	0.263	0.022	4.109	0.344	3.738	0.312
30/12/2002	17.078	0.672	0.900	0.035	0.560	0.022	8.731	0.343	7.943	0.312
Total	331.526	0.672	17.476	0.035	10.865	0.022	169.497	0.344	154.193	0.312

After the scrap passing the melting process, there was inspection the chemical composition received. In Tables 4.8 and 4.9, they show the chemical composition received by demonstrating in weigh and percent each day in December and November. The percent of carbon, sulfur, phosphorous, manganese, and silicon are still 0.67, 0.035, 0.022,0.344, 0.312 percent respectively.

4.3.3 Time utilization of melting the scrap 4 baskets

From the data record of 1302 heat or 2 months, we can analyze the using the average energy of the melting the raw material of 1 heat can be shown in the figure below.

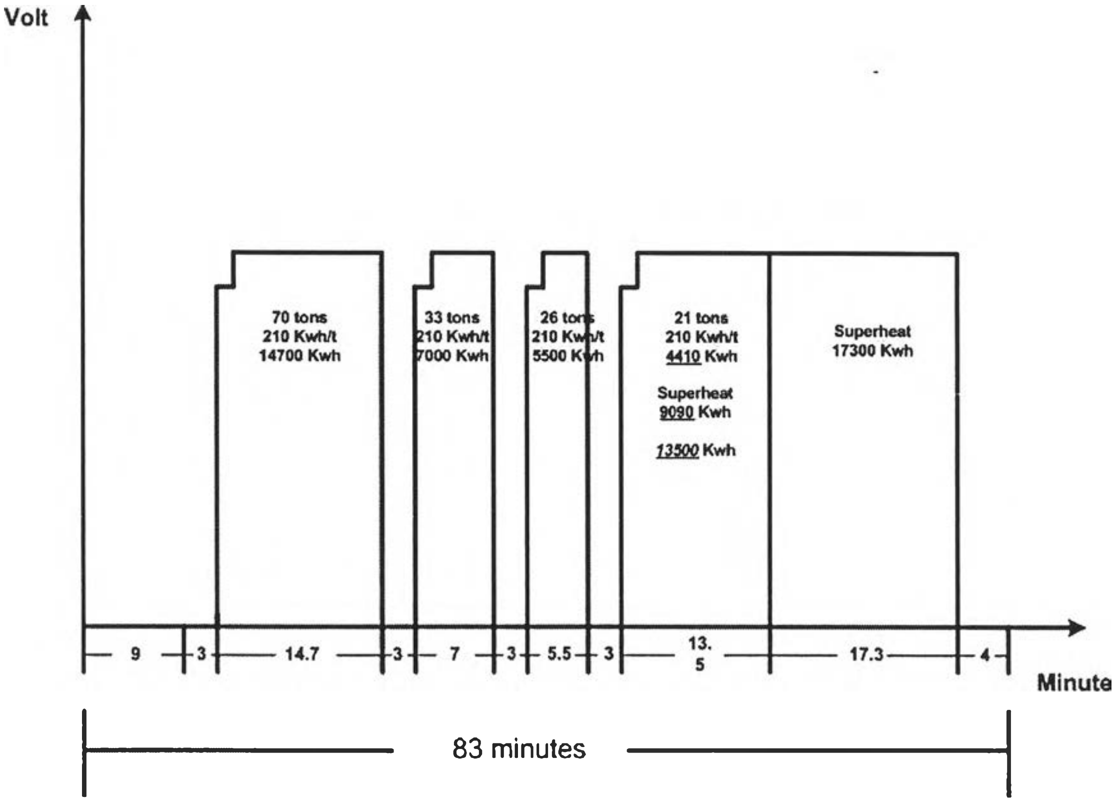

Figure 4.8 Procedure of used energy and time for melting process for 4-basket pattern

According to the procedure above, we found that

On time	=	58 mins/heat
Off time	=	25 mins/heat
Total	=	83 mins/heat

On time 58 minutes can be separate into:

On Ttime

From Scrap: $\frac{150t \; x \; 341 \, Kwh / t}{1000 \, Kwh / \min}$ = 50.979 minute

From Addition Lime: $\frac{7.1t \; x \; 1000 Kwh / t}{1000 Kwh / \min}$ = 7.1 minutes

Off time 25 minutes can be separate into:

<u>*OFF Time*</u>

Charging bucket 4 times	=	12 minutes
Tapping time	=	4 minutes
Other	=	9 minutes

4.3.4 Yield result

Scrap using = 149.5 tons

Production receiving = 112.12 tons

Yield = $\frac{112.12}{149.5} x100$ percent

= 75 percent

If the company has the target that the company will manage the raw material to the baskets by receiving the total density of all 4 basket equaling 0.85 ton/m^3 and having the chemical composition as shown in the table below:

Table4.10 The standard chemical composition of managing 2 baskets

Grade	***%C***	***%P***	***%S***	***%Mn***	***%Si***	***O_2 ppm***
MS00001	1.221	0.053	0.048	0.501	0.432	700-800

If the company can mixing the raw material before charging to the EAF, the company will cut using the lime stone to 5,200 kilograms from 7,100 kilograms and has the increasing yield to 85% (following the practical of the report of the Japanese company).

4.3.5 Melting time for 2 basket received from calculation

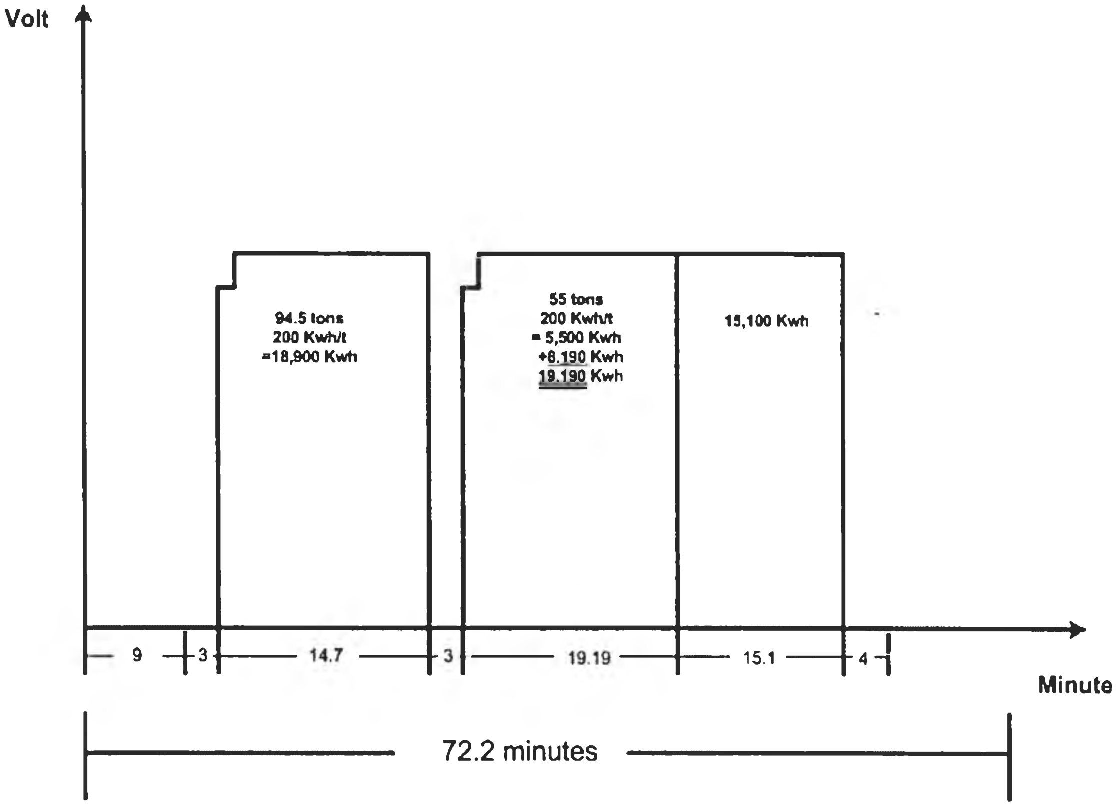

Figure 4.9 Procedure of used energy and time for melting process for 2-basket pattern

From the chart above, we can analyze that chart by separating to On Time and Off Time as shown below:

<u>On Time</u>

From Scrap: $\dfrac{149.5t \; x \; 321 \, Kwh/t}{1000 \, Kwh/\min} = 47.99$ minutes

From Addition: $\dfrac{5200t \; x \; 1000Kwh/t}{1000Kwh/\min} = 5.2$ minutes

Total = 53.19 minutes

<u>Off Time</u>

Charging = 6 minutes

Tapping = 4 minutes

Other = 9 minutes

Total = 19 minutes

Scrap using = *149.5 tons*

Production receiving = *127.07 tons*

Yield = $\frac{127.07}{149.5} x100$ *percent*

= *85 percent*

According to this result, if we take this result to compare with the current result at the same quantity of scrap, the comparison of both can be shown in the table below:

Table 4.11 The comparison result between the current managing scrap and the calculating the result of managing the scrap to improvement at density 0.6 ton/m^3 and 0.85 ton/m^3 respectively

Item	***Current managing scrap***	***Calculating to Improving***	***Difference***
Scrap	149.5 tons/heat	149.5 tons/heat	0
Production	112.12 tons/heat	127.07 tons/heat	14.95
Yield	75%	85%	10%
On-Time			
-Scrap	50.98 minutes	47.99 minutes	(-29) minutes
-Addition Flux	7.1 minutes	5.2 minutes	(-1.9) minutes
Off-Time			
-Charging	12 minutes	6 minutes	(-6) minutes
-Tapping	4 minutes	4 minutes	0
-Other	9 minutes	9 minutes	0
T-T-T	83 minutes	72.2 minutes	(-10.8) minutes

4.3.6 Disadvantage managing the 4-basket pattern

Disadvantages of managing the raw materials (scrap, pig iron, flux and so on) 4 baskets at density 0.6 tons/m^3 can be shown below:

Table 4.12 Disadvantages of managing the raw materials 4 baskets at density 0.6 tons/m^3

Disadvantage	***Lose time/heat (minutes)***	***Loss time/2months (minutes)***	***%***
Long time for Melting scrap time	2.9	3,775.80	26.85
Long time for Melting Addition time	1.9	24,738	17.59
Long time for Charging the baskets to EAF	6	7,812	55.56
Total	**10.8**	**36325.8**	**100**

According to Tables 4.11 and 4.12, these data can be shown in the Pareto chart demonstrate the lost time due to managing scrap 4 baskets in figure 4.10, crap using, production quantity, and yield in November and December in figure 4.11 and total scrap using, production quantity, and yield in 2 months in figure 4.12

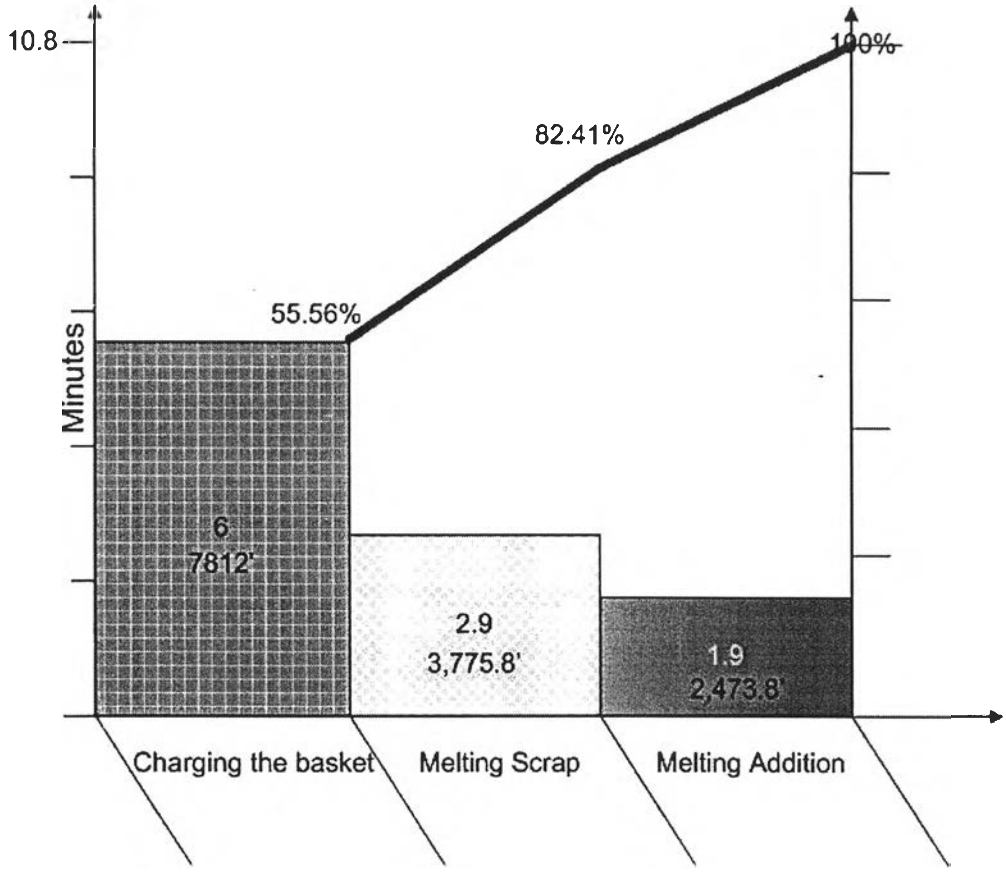

Figure 4.10 The Pareto chart of lose time due to managing 4 baskets

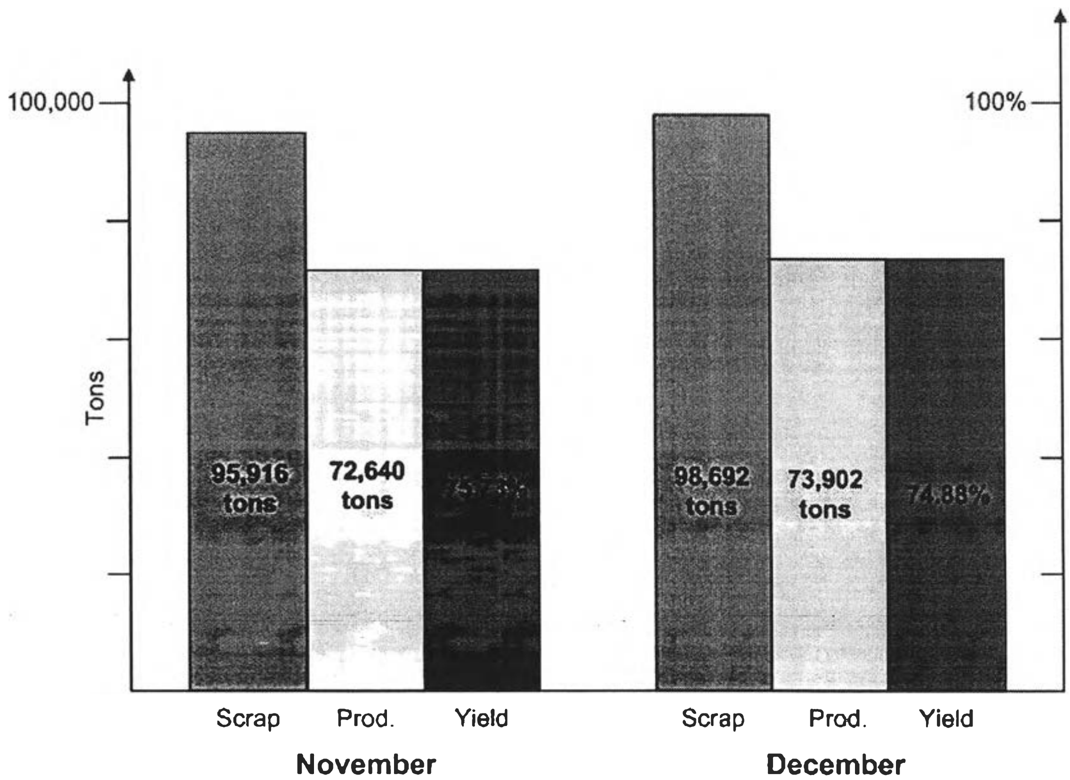

Figure 4.11 Scrap using, production quantity, and yield in November and December

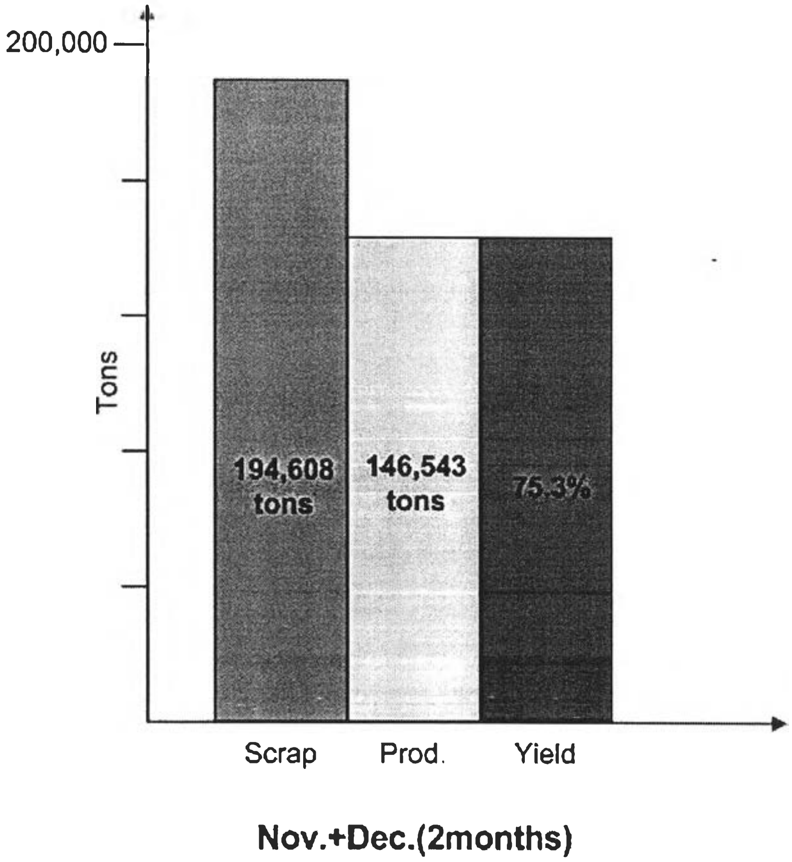

Figure 4.12 Total Scrap using, production quantity, and yield in 2 months

4.3.7 The utilizing of flux for 4 baskets

The detail of utilizing flux can be show below:

- Add to the basket

Table 4.13 Charging Flux in Scrap basket

CaO (*Kg*)	*Dolomite* (*Kg*)
500	-

- Add between melting by EAF Material Weighting/Charging

Table 4.14 EAF material Weighting/Charging

Charge No.	*Bin No.2 CaO*	*Bin No.3 B-Dolomite*
1st	2100	1200
2nd	940	1000

- Add before refining by Tapping Material Weighting/Charging

Table 4.15 Tapping Material weighting/Charging

Bin No.2 CaO	*Bin No.5 B-Dolomite*
1400	60

According to utilizing the flux above, the total flux utilizes are :

Total Flux = flux added to basket+ flux added between melting + flux added before refining

$= 500_{CaO}+\{(2100+940)_{CaO}+(1200+1000)_{B\text{-dolomite}}\} + \{1400_{CaO}+60_{B\text{-Dolomite}}\}$

$= 500+3040+2200+1460$

$= 7200$ Kgs

All of these show the current situation of the company that confront with the problems that making the company loss the profit not only come from yield but also relation with production time, Addition added in the process. So the company should find the method of solving these problems. In the next chapter, it will show the countermeasure and planning for solving these problems.