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Studying the Losses in Energy Furnace no. 1, 2, 3 and 4 at Tube Plant at GIL

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Abstract: The process of Graphitization is complex. The standard graphitization process entails heating up a carbon part (porous or nonporous) to between 1,000°C and 2,800°C and infusing it with a humidified gas. The parts undergo long treatments and pressure matrix cycles (vacuum and gas pressure). The treatment is done in a reducing atmosphere (nitrogen or argon atmosphere at atmospheric pressure, reduced pressure or in a vacuum). DC Induction furnaces are used for these complex procedures. There are various losses occurring in electrical energy consumption in furnaces which are to be duly calculated and then the findings are studied.

I. INTRODUCTION

A. About Graphite India Limited

Graphite India Limited (GIL) is the pioneer in India for manufacture of Graphite Electrodes as well as Carbon and Graphite Specialty products. GIL's manufacturing facilities are spread across 6 plants in India and it has also got a 100% owned subsidiary at Nuremberg, Germany, by name Graphite COVA GmbH.

B. History

Having started in 1967 in collaboration with erstwhile Great Lakes Carbon Corporation (GLCC) of USA, GIL has been continually improving its product quality and services thereby scaling newer heights of excellence and customer recognition. This journey has been fueled by our reliance on cutting-edge technology, a natural penchant for innovation and creativity, eco-friendly approach in production process, consistency of product quality and services as well as productivity and cost optimization.

C. Graphitization

Graphitization is the formation of graphite (free carbon) in iron or low-alloy steel, which occurs when their components are exposed to elevated temperatures over a long period.

Graphitization can be defined as the structural change from highly disordered or defective carbon atom structures towards a perfect 3D crystal of pure graphite. Preferably, graphite is arranged in layers, each of these layers is a separate supra-molecule called graphene (refer Figure 1).

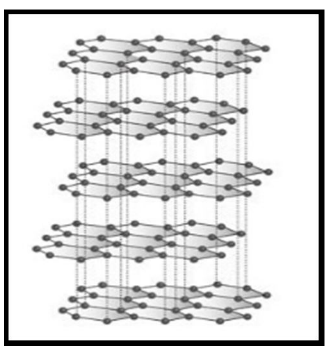

Figure 1. Cut out of carbon atom layers (aka graphene) in graphite

The ordering process is started by heat treatment up to 3000 °C in inert atmosphere. The original carbon material contains multiple small domains of graphene molecules known as basic structural units (BSU). During heat treatment those small domains grow, all differences in orientation of the layers are removed and large straight layers are developed, as shown in Figures 2 and 3.

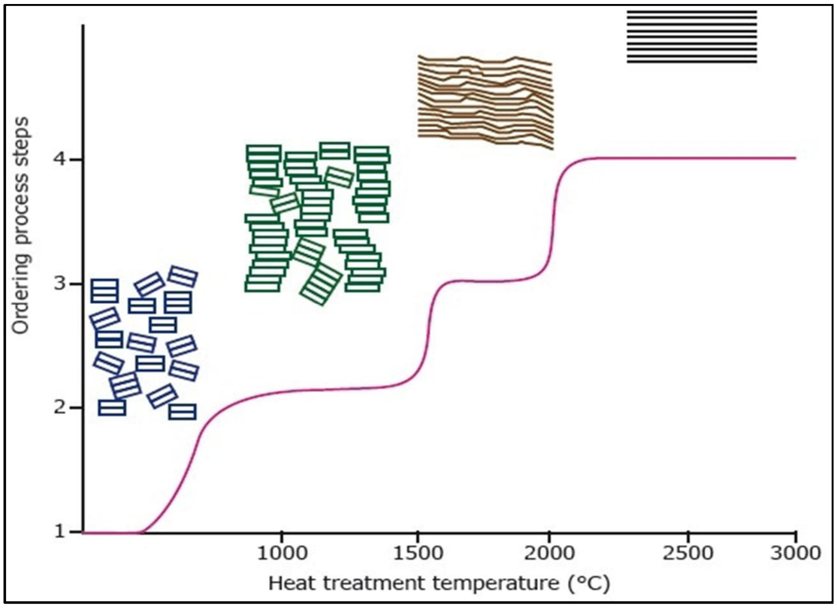

Figure 2. Representation of the graphitization process and of ordering the BSU (basic structural units) of the graphite with increasing temperature.

After carbonization, the carbon atoms are in chaotic order and thus do not have suitable properties. Raising the temperature allows the atoms to travel to more suitable positions as illustrated in Figure 2 and ultimately, at extremely high temperatures, to form ideal graphite with superior properties.

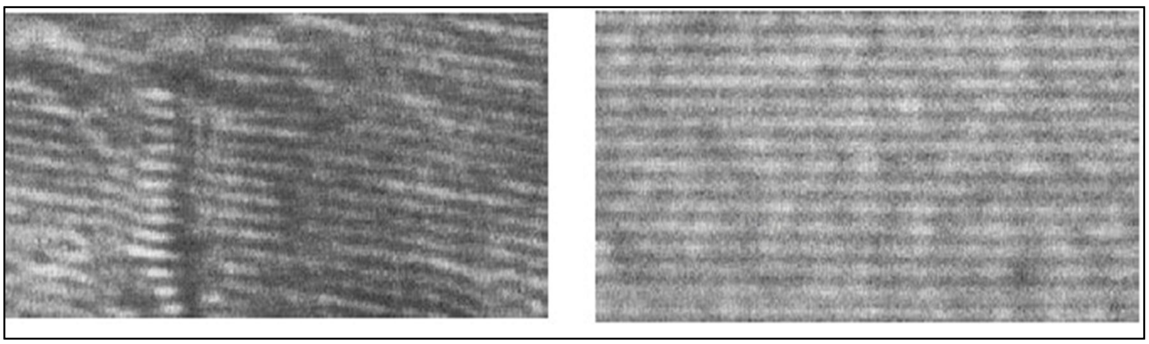

Figure 3. Electron microscope pictures: left graphite layers before heat treatment with disordered layers and right after heat treatment up to 2200 °C with completely straightened layers

D. Scope of Work

Graphitization of carbon rods is done in the four furnaces at the tube plant. The load put on the different furnaces is almost identical, in spite of that there is huge differences in Energy Meter reading of all the furnaces.

This project revolves around finding out and studying the electrical losses in Heating Treatment Furnace no. 1,2,3,4 by identifying the power circuitry of all the system connected to the Induction furnace and studying the cause of losses.

II. EQUIPMENT'S IN POWER CIRCUIT

A. Air Circuit Breaker (ACB)

Air circuit breaker is a type of breaker that operates in air, as an arc quenching medium, at a given atmospheric pressure. Air circuit breakers are devises that offer short current and overcurrent protection to circuits that range between 800 Amps and 10,000 Amps. These are typically used in low voltage applications below 450 Volts and come with two pairs of contacts, the main pair carries the current at a steady load rate and is made of copper. The other pair is the arcing contact and usually made up of carbon.

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1) *Operation of Air Circuit Breakers***:** Whenever a fault occurs, the main pairs of contact are initially separate, and the current shifts to the arching contact making the arc pair stand separate in an arcing position. This arc is forced upwards by the thermal action and electromagnetic forces. The ends of the arc pair now travel along the arc runner, and the arc splitter plates then split them apart. The arc is finally extinguished by cooling, splitting lengthening, etc.

Figure 5: ACB

B. Transformer

A Transformer is a static electrical machine which transfers AC electrical power from one circuit to the other circuit at the constant frequency, but the voltage level can be altered that means voltage can be increased or decreased according to the requirement.
It works on the principle of Faraday's Law of Electromagnetic Induction which states that "the magnitude of voltage is directly proportional to the rate of change of flux."

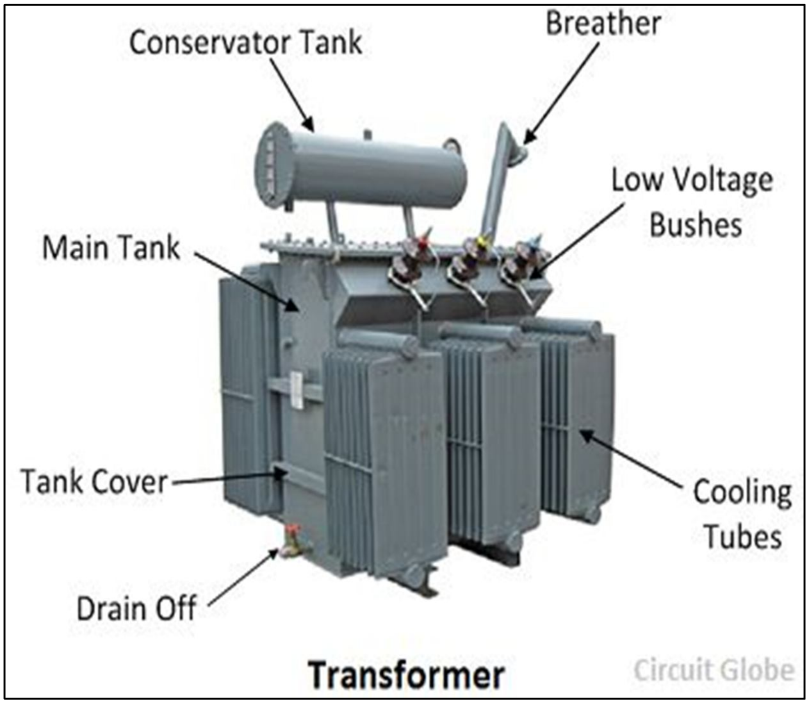

Figure 6. Transformer

Electrical transformers are machines that transfer electricity from one circuit to another with changing voltage level but no frequency change. Today, they are designed to use AC supply, which means that fluctuation in supply voltage is impacted by the fluctuation in the current. So, an increase in current will bring about an increase in the voltage and vice versa.
Transformers help improve safety and efficiency of power systems by raising and lowering voltage levels as and when needed. They are used in a wide range of residential and industrial applications, primarily and perhaps most importantly in the distribution and regulation of power across long distances.

1) *Operation of Transformer:* An electrical transformer uses Faraday's electromagnetic induction law to work – "Rate of change of flux linkage with respect to time is directly proportional to the induced EMF in a conductor or coil". A transformer's physical basis lies in the mutual induction between two circuits that are linked by a common magnetic flux. It is usually equipped with 2 windings: primary and secondary. These windings share a magnetic core that is laminated, and the mutual induction that takes place between these circuits helps transfer electricity from one point to another. Depending on the amount of linked flux between the primary and secondary windings, there will be different rates of change in flux linkage. To ensure maximum flux linkage, i.e. maximum flux passing through and linking to the secondary winding from the primary, a low reluctance path is placed common to both windings. This leads to greater efficiency in working performance, and forms the core of the transformer. The application of alternating voltage to the windings in the primary side creates an alternating flux in the core. This links both windings to induce EMF in the primary as well as the secondary side. EMF in the secondary winding causes a current, known as load current, if there is a load connected to the secondary section. This is how electrical transformers deliver AC power from one circuit (primary) to another (secondary), through the conversion of electrical energy from one value to another, changing the voltage level but not the frequency.

C. Auto Transformer

A transformer that has a single winding is known as an Auto Transformer. The term 'auto' is taken from a Greek word and the meaning of this is single coil works alone. The working principle of the autotransformer is similar to a 2-winding transformer but the only difference is, the portions of the single winding in this transformer will work at both sides of the windings like primary & secondary. In a normal transformer, it includes two separate windings that are not allied with each other. Autotransformers are lighter, smaller, cheaper comparing with other transformers, but they will not provide electrical isolation between two windings.

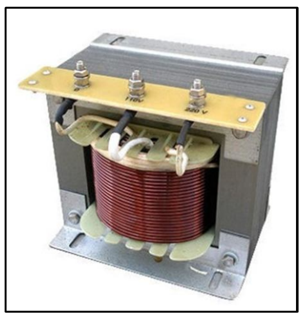

Figure 7. Auto Transformer

1) *Auto Transformer Construction*: We know that the transformer includes two windings namely primary and secondary which are connected magnetically but insulated electrically. But in autotransformer, a single winding is used like both the windings. There are two types of autotransformer based on construction. In one type of transformer, there is continuous winding with the taps brought out at convenient points determined by the desired secondary voltage. However, in another type of autotransformer, there are two or more distinct coils that are electrically connected to form a continuous winding. The construction of Autotransformer is shown in the figure below.

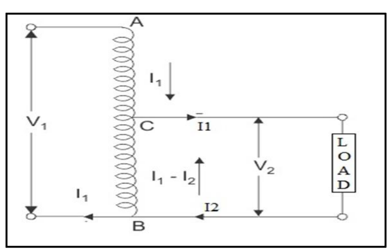

Figure 8: Auto Transformer construction.

The primary winding AB from which a tapping at 'C' is taken, such that CB acts as a secondary winding. The supply voltage is applied across AB, and the load is connected across CB. Here, the tapping may be fixed or variable. When an AC voltage V1 is applied across AB, an alternating flux is set up in the core, as a result, an emf E1 is induced in the winding AB. A part of this induced emf is taken in the secondary circuit.

In the above diagram, the winding is represented as 'AB' whereas the total turns 'N1' is considered as the primary winding. In the above winding, from the 'C' point it is tapped as well as the 'BC' section can be considered like secondary winding. Assume the number of turns among the points B&C is 'N2'. If the voltage 'V1' is applied across the winding AC, then the voltage for each turn within the winding will be V1/N1.

Therefore, the voltage across the BC section of the winding will be **(V1/N1) *N2**

From the above construction, voltage for this BC winding is 'V2'

Therefore, V1/N1) *N2 =V2

V2/V1 = N2/N1 = K

When the BC section in the AB winding can be considered secondary. So 'K' is the constant value, it is nothing but the ratio of voltage or turns in the transformer.

Whenever the load is connected in between the BC terminals, then the load current like 'I2' will starts flowing. The flow of current within the secondary winding will be the main difference of currents 'I1&I2'.

D. Rectoformer

A Rectiformer is a rectifier and transformer designed and built as a single entity for converting alternating current into direct current. It is piece of power systems equipment rather than an electronics component. Rectiformers are used for supplying power to different field of ESP (electrostatic precipitator). Rectiformers are also used to create dc supply for Hall process cells in the aluminum smelting industry. Rectiformers are commonly found in Electrowinning operations, where a direct current is required to convert base metal ions such as copper to a metal at the cathode. The passage of an electric current through a purified copper sulfate solution produces cathode copper.

A rectifier transformer is a transformer which includes diodes or thyristors in the same tank. Voltage regulation may also be included. Rectifier transformers are used for industrial processes which require a significant direct current (dc) supply. Typical processes would include dc traction, electrolysis, smelting operations, large variable speed drive trains, etc.

The application for which the transformer is used, will drive the design considerations including:

1) Bridge type connection of the thyristors for higher voltages
2) Interphase connection for low voltage, high current applications
3) Number of pulses (6, 12 and higher with phase shifting)
4) Eddy current and harmonic issues

Voltage regulation is achieved with no-load or on-load tap changers on the high voltage side. Fine levels of voltage regulation can be achieved using saturable reactors on the secondary side. Regulation units may be built in or separate.

III. LOSSES OCCURRING IN THE FURNACE

There are two types of losses occurring in the Induction Furnace:

A. Electrical Losses

Electrical Losses occurring the furnace are mainly due to the transformer providing input to the furnace. In any electrical machine, 'loss' can be defined as the difference between input power and output power. An electrical transformer is a static device, hence mechanical losses (like windage or friction losses) are absent in it. A transformer only consists of electrical losses (iron losses and copper losses). Transformer losses are similar to losses in a DC machine, except that transformers do not have mechanical losses.

Losses in transformer are explained below –

1) *Core Losses or Iron Losses: Eddy current loss and hysteresis loss depend upon the magnetic properties of the material used for the construction of core. Hence these losses are also known as core losses or iron losses.*

a) Hysteresis loss in transformer: Hysteresis loss is due to reversal of magnetization in the transformer core. This loss depends upon the volume and grade of the iron, frequency of magnetic reversals and value of flux density. It can be given by, Steinmetz formula

   $W_h = \eta B_{max}^{1.6} f V$(watts)

   where, η= Steinmetz hysteresis constant

   V = volume of the core in m^3

b) Eddy current loss in transformer: In transformer, AC current is supplied to the primary winding which sets up alternating magnetizing flux. When this flux links with secondary winding, it produces induced emf in it. But some part of this flux also gets linked with other conducting parts like steel core or iron body or the transformer, which will result in induced emf in those parts, causing small circulating current in them. This current is called as eddy current. Due to these eddy currents, some energy will be dissipated in the form of heat.

2) *Copper Loss in Transformer:* Copper loss is due to ohmic resistance of the transformer windings. Copper loss for the primary winding is I12R1 and for secondary winding is I22R2. Where, I1 and I2 are current in primary and secondary winding respectively, R1 and R2 are the resistances of primary and secondary winding respectively. It is clear that Cu loss is proportional to square of the current, and current depends on the load. Hence copper loss in transformer varies with the load.
3) *Efficiency of Transformer:* Just like any other electrical machine, efficiency of a transformer can be defined as the output power divided by the input power. That is efficiency = output / input. Transformers are the most highly efficient electrical devices. Most of the transformers have full load efficiency between 95% to 98.5%. As a transformer being highly efficient, output and input are having nearly same value, and hence it is impractical to measure the efficiency of transformer by using output / input. A better method to find efficiency of a transformer is using, efficiency = (input - losses) / input = 1 - (losses / input).

4) *All Day Efficiency of Transformer*

Ordinary or commercial efficiency of a transformer can be given as

$$\text{ordinary efficiency} = \frac{\text{output (in watts)}}{\text{input (in watts)}}$$

But in some types of transformers, their performance cannot be judged by this efficiency. For example, distribution transformers have their primaries energized all the time.

But, their secondaries supply little load all no-load most of the time during day (as residential use of electricity is observed mostly during evening till midnight).

That is, when secondaries of transformer are not supplying any load (or supplying only little load), then only core losses of transformer are considerable and copper losses are absent (or very little). Copper losses are considerable only when transformers are loaded. Thus, for such transformers copper losses are relatively less important. The performance of such transformers is compared on the basis of energy consumed in one day.

$$\text{All day efficiency} = \frac{\text{output (in kWh)}}{\text{input (in kWh)}} \quad \text{(for 24 hours)}$$

All day efficiency of a transformer is always less than ordinary efficiency of it.

B. Heat Losses

Induction furnace losses include:

1) Heat storage in the furnace structure.
2) Losses from the furnace outside walls or structure.
3) Heat transported out of the furnace by the load.
4) Radiation losses from openings, hot exposed parts, etc.
5) Heat carried by the cold air infiltration into the furnace.

Heat losses take place while the furnace is in production. Wall or transmission losses are caused by the conduction of heat through the walls, roof, and floor of the heating device, Once that heat reaches the outer skin of the furnace and radiates to the surrounding area or is carried away by air currents, it must be replaced by an equal amount taken from the combustion gases. This process continues as long as the furnace is at an elevated temperature.

IV. RESULTS

A. Data Gathered before Changing Insulation

1) % Loss from the Data provided for furnace no. 3

Date	Total KW	Energy meter reading	Difference	% Difference
01/09/2019	1962.1	2474.1	512.1	28.08
02/09/2019	1922.81	2582.2	660.2	29.27
03/09/2019	1842.84	2359.8	516.96	24.60
04/09/2019	1757.53	2446.9	689.37	32.79
05/09/2019	1920.575	2294.2	373.63	17.72
06/09/2019	1928.472	2175.9	247.43	12.05
07/09/2019	1948.07	2342.6	394.53	18.39
08/09/2019	1851.45	2218.3	366.85	18.08
09/09/2019	1978.57	2319	340.43	15.84
10/09/2019	2031.17	2476	444.83	19.73

Table 1: Data from furnace no. 3 before changing insulation.

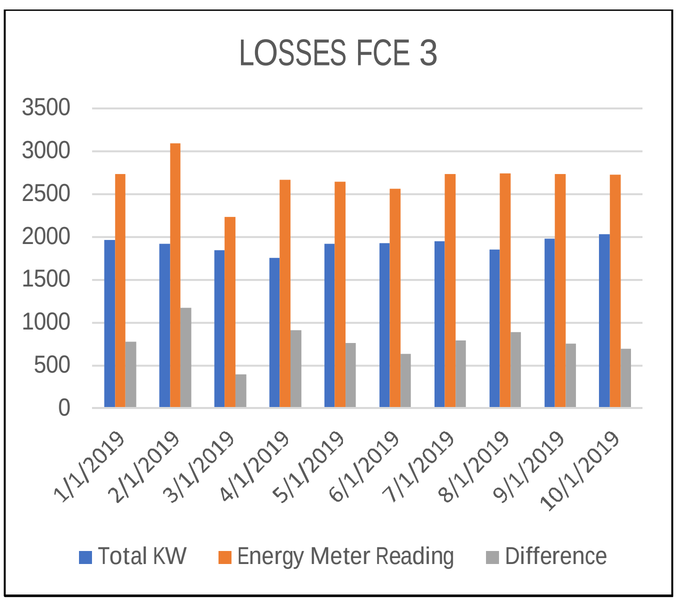

Chart: Losses observed in furnace no. 3

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2) % Loss from the Data provided for furnace no. 1

DATE	TOTAL KW	ENERGY METER READING	DIFFERENCE	% DIFFERENCE
08-08-2019	2048.98	3001.1	952.12	37.7
09-08-2019	1954.62	2761.4	806.78	34.21
10-08-2019	2033.43	3019.9	986.47	39.04
11-08-2019	2048.61	3011.2	962.59	38.04
12-08-2019	1997.99	3058.27	1060.28	41.93
13-08-2019	2120.82	3107.7	986.88	37.74
14-08-2019	2167.14	3320	1152.86	42.02
15-08-2019	2118.27	3207.3	1089.03	40.89
16-08-2019	2214.78	3359.9	1145.12	410.8
17-08-2019	2180.95	3127.9	946.95	35.04
18-08-2019	2106.9	3243.84	1136.94	42.49
19-08-2019	1893.21	2899.42	1006.21	41.99
20-08-2019	1913.83	2889.23	975.4	40.61
21-08-2019	1825.24	2902.6	1077.36	45.57
22-08-2019	1751.61	2387	635.39	30.7
23-08-2019	1594.46	2337	742.54	37.77
24-08-2019	1591.47	2369.7	778.23	39.29
25-08-2019	1692.37	2606.3	913.93	42.52
26-08-2019	1611.52	2535	923.48	44.54
27-08-2019	1680.96	2466.06	785.1	37.86
28-08-2019	1594.57	2379.83	785.26	39.57

Table 2: Data from furnace no. 1 before changing insulation.

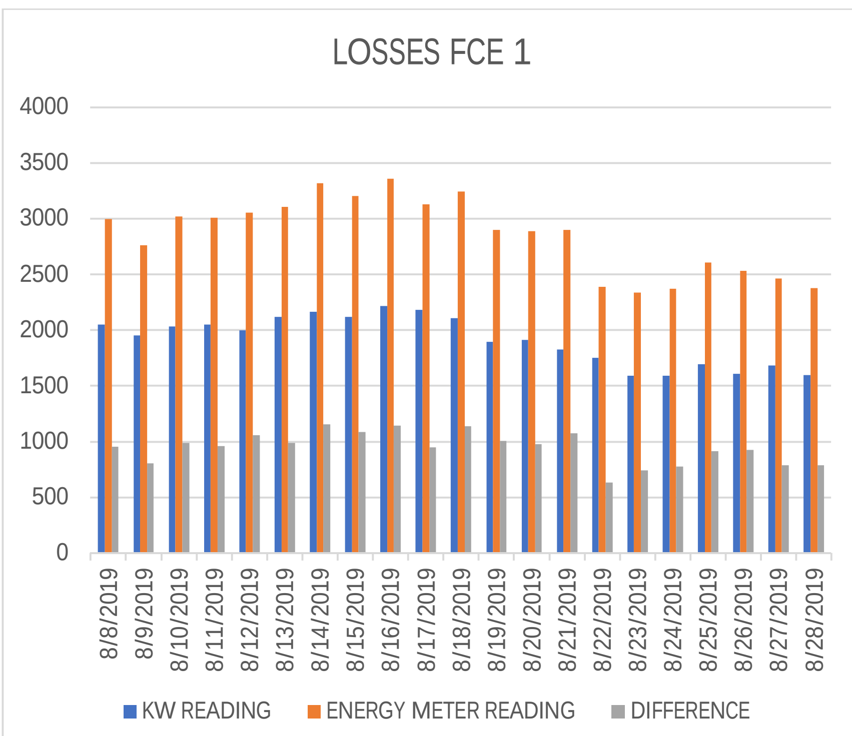

Chart: Losses observed in furnace no. 1

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3) % Loss from the Data provided for furnace no. 2

DATE	TOTAL KW	ENERGY METER READING	DIFFERENCE	% DIFFERENCE
08-08-2019	2400.95	1540.34	860.61	43.67
09-08-2019	2913.36	2818.08	95.28	3.22
10-08-2019	2969.6	2823.2	146.4	5.05
11-08-2019	2910.87	2830.48	80.39	2.8
12-08-2019	2678.26	2595.52	82.74	3.13
13-08-2019	2140.23	2282.98	142.75	6.45
14-08-2019	2303.02	2700	396.98	15.86
15-08-2019	2092.97	2514.7	421.73	18.3
16-08-2019	2262.64	2536.9	274.26	11.43
17-08-2019	2185.71	2634.3	448.59	18.61
18-08-2019	2271.62	2769.08	497.46	19.73
19-08-2019	2068.67	2349.66	280.99	12.71
20-08-2019	2156.54	2304.58	148.04	6.63
21-08-2019	2419.22	2646.29	227.07	8.96
22-08-2019	2809.15	2878.02	68.87	2.42
23-08-2019	2503.86	2731.08	227.22	8.68
24-08-2019	2990.04	3199.2	209.16	6.75
25-08-2019	3030.52	3205.53	175.01	5.61
26-08-2019	3052.59	2984.44	68.15	2.25
27-08-2019	3120.44	3357.56	237.12	7.32
28-08-2019	1079.24	1013.19	66.05	6.31

Table 3: Data from furnace no. 2 before changing insulation.

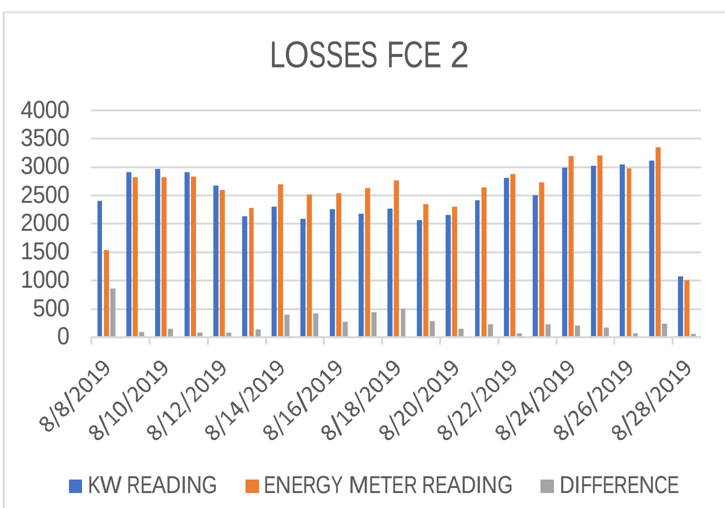

Chart: Losses observed in furnace no 2

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4) % Loss from the Data Provided for Furnace no. 4

Date	Total kw	Energy meter reading	Difference	% difference
01-09-2019	2245.88	2736	490.12	19.67
02-09-2019	2120.05	3095	974.95	37.38
03-09-2019	2030.52	2236	205.48	9.63
04-09-2019	2027.93	2669	641.07	27.29
05-09-2019	2008.5	2647	638.5	27042
06-09-2019	1980.49	2560	579.51	25.52
07-09-2019	2108.83	2738	629.17	25.96
08-09-2019	2082.48	2741	658.52	27.3
09-09-2019	2071.43	2736	664.57	27.64
10-09-2019	2147.83	2728	580.17	23.79

Table 4: Data from furnace no. 4 before changing insulation.

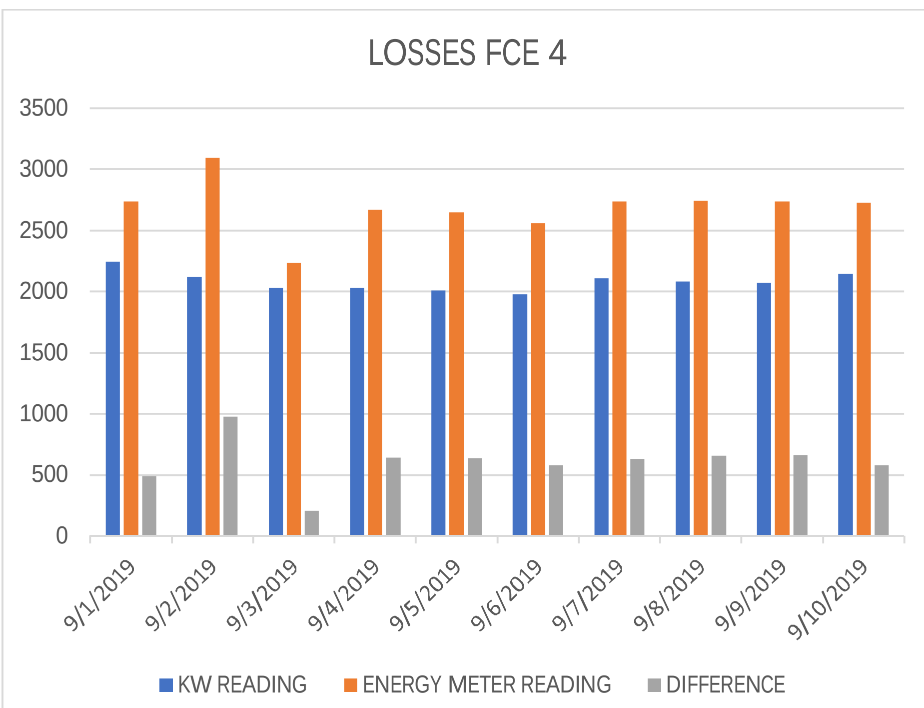

Chart: Losses observed in furnace no. 4

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B. Data gathered from Furnace after Changing Insulation

1) % Loss from the Data provided for furnace no. 3

DATE	TOTAL KW	ENERGY METER READING	DIFFERENCE	% DIFFERENCE
16-01-2020	1905.62	2153	247.38	12.19
17-01-2020	2631.41	3076	444.59	15.57
18-01-2020	2499.98	3131	631.02	22.41
19-01-2020	2572.87	3131	558.13	19.57
20-01-2020	2518.9	3167	648.1	22.79
21-01-2020	2678.34	3177	498.66	17.03
22-01-2020	2700.56	3238	537.44	18.1
23-01-2020	2667.84	3180	512.16	17.51
24-01-2020	2823.68	3124	300.32	10.09
25-01-2020	3444.74	3070	374.74	11.5
26-01-2020	2672.81	3171	498.19	17.05
27-01-2020	2724.51	3307	582.49	19.31
28-01-2020	2728.96	3255	526.04	17.58
29-01-2020	2730.4	3293	562.6	18.68
30-01-2020	2732.92	3208	475.08	15.99
31-01-2020	2631.43	3156	524.57	18.12

Table 5: Data from furnace no. 3 after changing insulation.

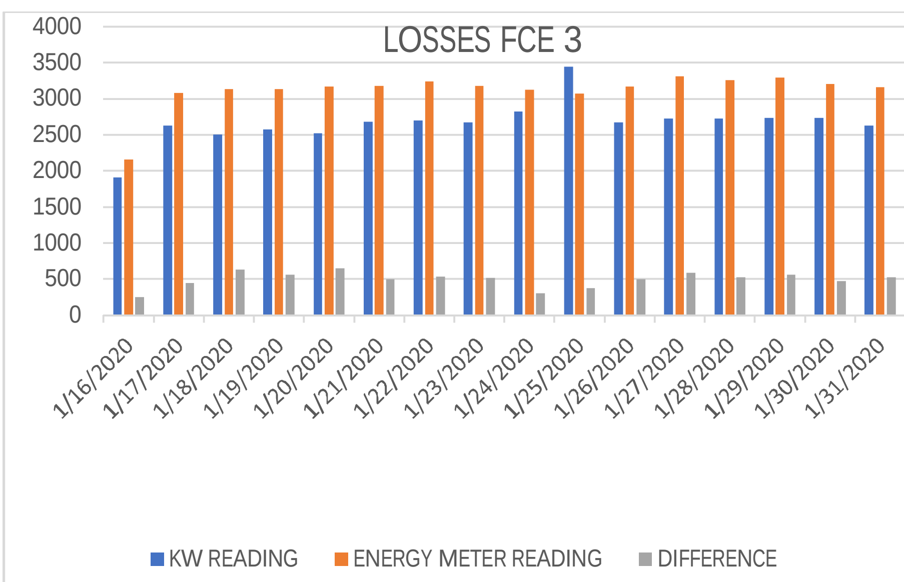

Chart: Losses observed in furnace no. 3

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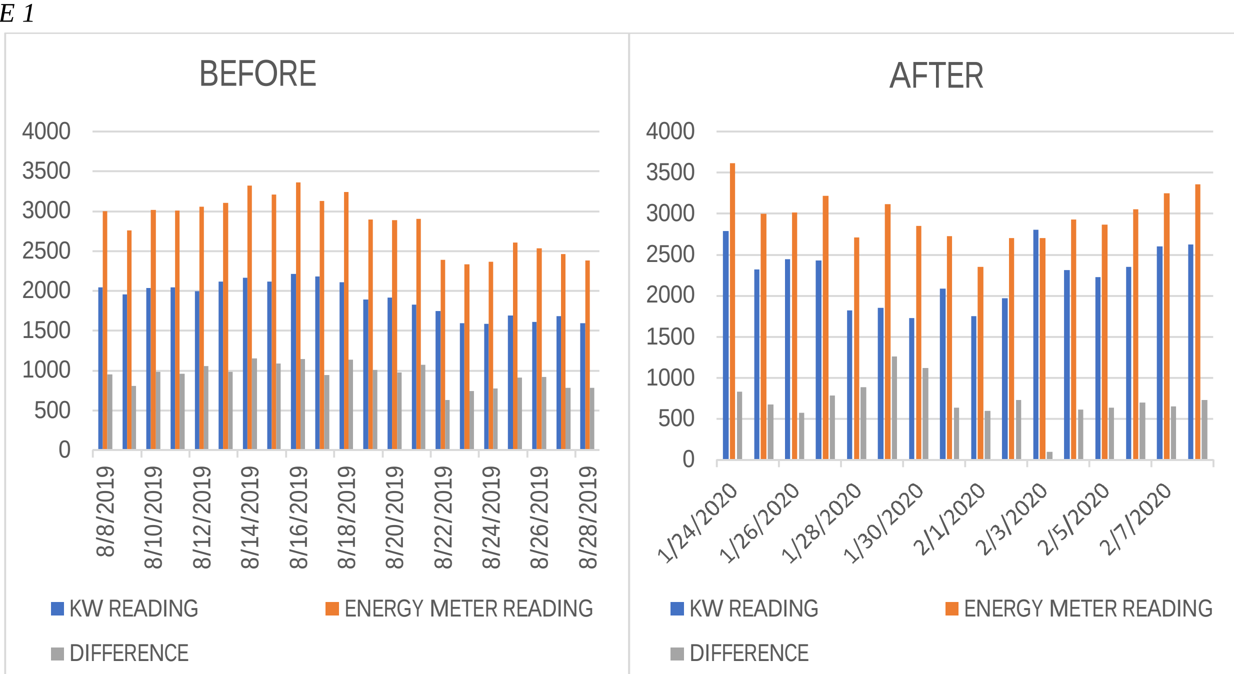
2) % Loss from the Data provided for furnace no. 1

DATE	TOTAL KW	ENERGY METER READING	DIFFERENCE	% DIFFERENCE
24-01-2020	2787.49	3617.1	829.61	25.9
25-01-2020	2322.56	2995.8	673.24	25.31
26-01-2020	2442.87	3014.7	571.83	20.95
27-01-2020	2427.25	3216.5	789.25	27.95
28-01-2020	1822.46	2709.8	887.34	39.15
29-01-2020	1854.25	3113.2	1258.95	49.18
30-01-2020	1732.54	2852.3	1119.76	48.84
31-01-2020	2088.58	2727.4	638.82	26.52
01-02-2020	1750.01	2348.7	598.69	29.21
02-02-2020	1970.48	2701.5	731.02	31.42
03-02-2020	2803.34	2701.8	101.54	3.56
04-02-2020	2314.46	2930.4	615.94	23.48
05-02-2020	2227.49	2863.2	635.71	24.97
06-02-2020	2352.13	3054.6	702.47	25.98
07-02-2020	2600.12	3251.3	651.18	22.25
08-02-2020	2623.37	3357.2	733.83	24.02

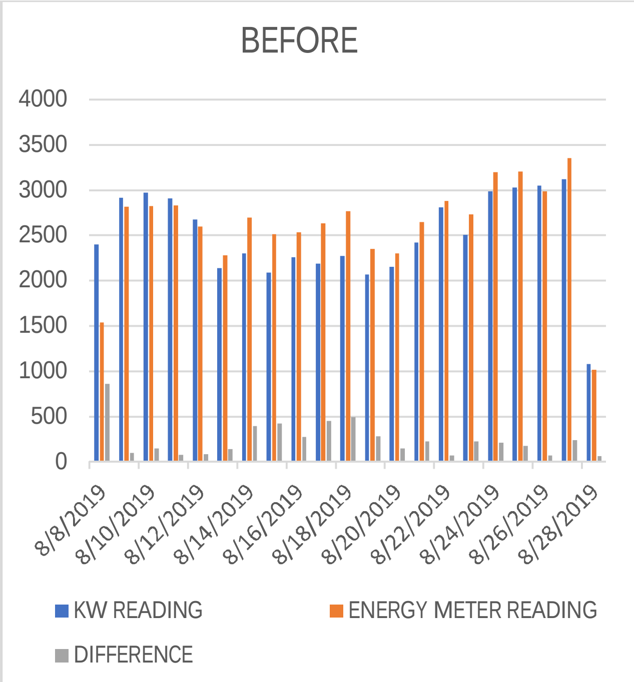
Table 6: Data from furnace no. 1 after changing insulation.

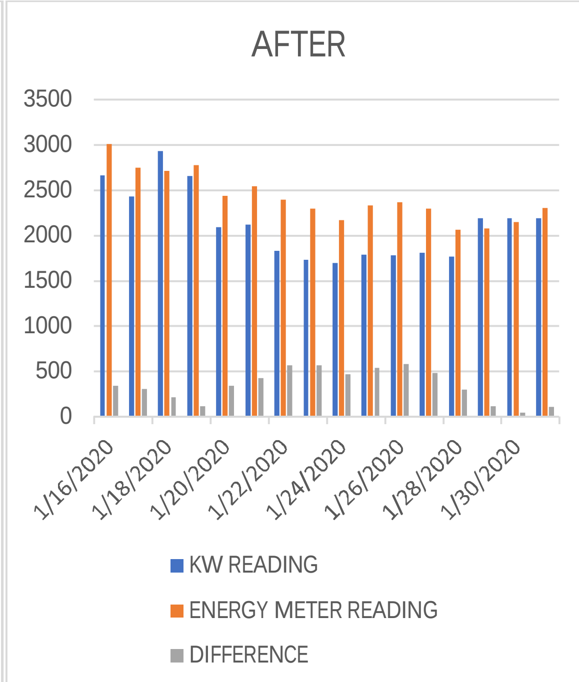
C. Before and After Comparison of data Gathered after Changing the Insulation.

1) FCE 1

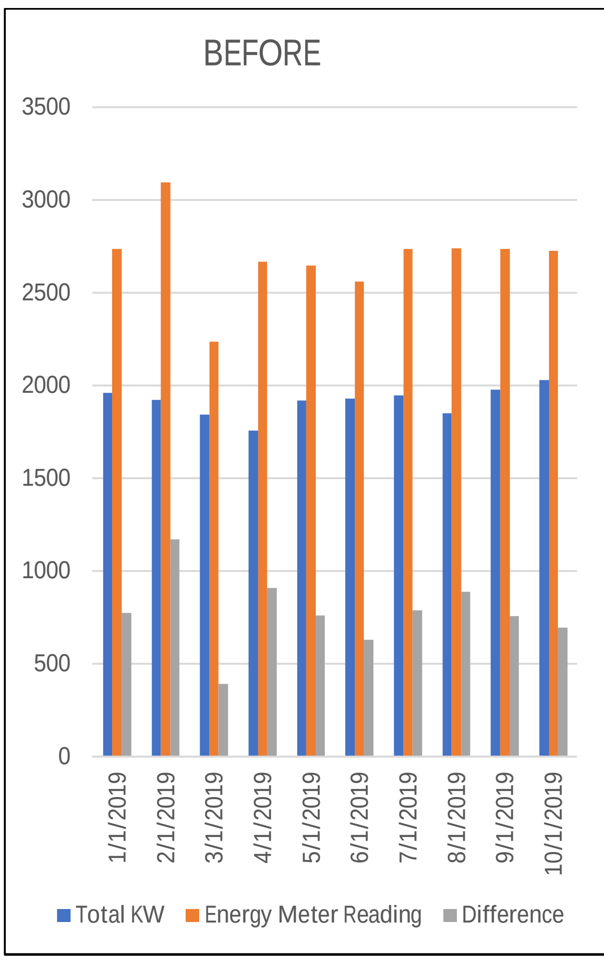


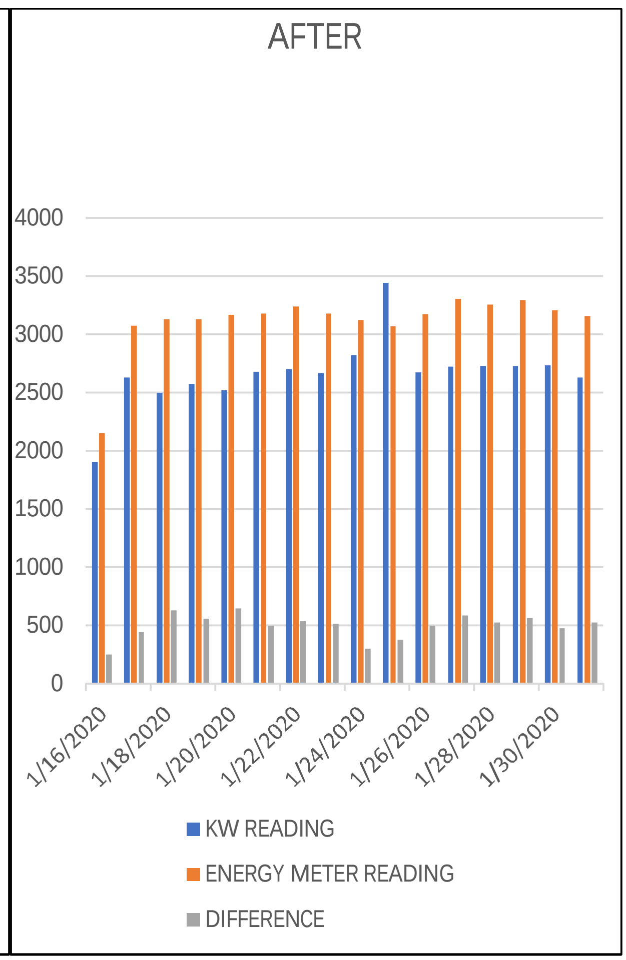
2) FCE 2


BEFORE
4000
3500
3000
2500
2000
1500
1000
500
0
8/8/2019
8/10/2019
8/12/2019
8/14/2019
8/16/2019
8/18/2019
8/20/2019
8/22/2019
8/24/2019
8/26/2019
8/28/2019
KW READING
ENERGY METER READING
DIFFERENCE


AFTER
3500
3000
2500
2000
1500
1000
500
0
1/16/2020
1/18/2020
1/20/2020
1/22/2020
1/24/2020
1/26/2020
1/28/2020
1/30/2020
KW READING
ENERGY METER READING
DIFFERENCE

3) FCE 3


BEFORE
3500
3000
2500
2000
1500
1000
500
0
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
10/1/2019
Total KW
Energy Meter Reading
Difference


AFTER
4000
3500
3000
2500
2000
1500
1000
500
0
1/16/2020
1/18/2020
1/20/2020
1/22/2020
1/24/2020
1/26/2020
1/28/2020
1/30/2020
KW READING
ENERGY METER READING
DIFFERENCE

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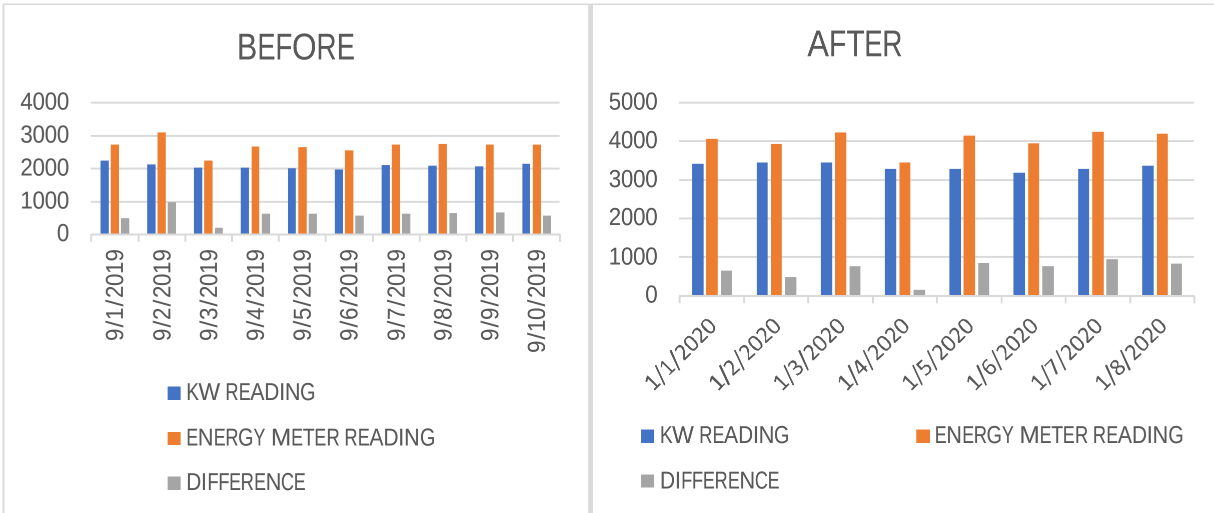
4) FCE 4



D. Observations

1) From the data received it has been observed that energy meter readings exceed the value of energy consumed.
2) In certain values the energy consumed value is exceeding the energy meter reading
3) After visual inspection of furnace and transformer connection, the busbars has more than safely allowed number of joints which increase the energy loses substantially.
4) It has also been observed that there is no single recto former unit but a current transformer is connected to rectifier unit and an auto transformer is used to change the tapping's of C.T.
5) Possibility of power factor imbalance has been considered from the line/AC supply coming towards C.T.
6) Possibility of electrical equipment failure has been rated out such as transformer arrangement because of it fulfilling the said parameter i.e. working at 30% loss at full load.
7) It has been observed from data acquired, that more than one type of material is processed from the furnace in a single day, so sudden change in material increases or decreases the amount of current required drastically thus putting an immense load on system in short amount of time.
8) After thoroughly studying the circuit diagram, apparatus and the type of equipment installed for conversion of AC to DC, no possible defects or damages have been found which may lead to loss in energy.
9) The type of rectifier used is very less efficient and has efficiency of 70% thus resulting in 30% losses.

Steps taken after the change of insulation

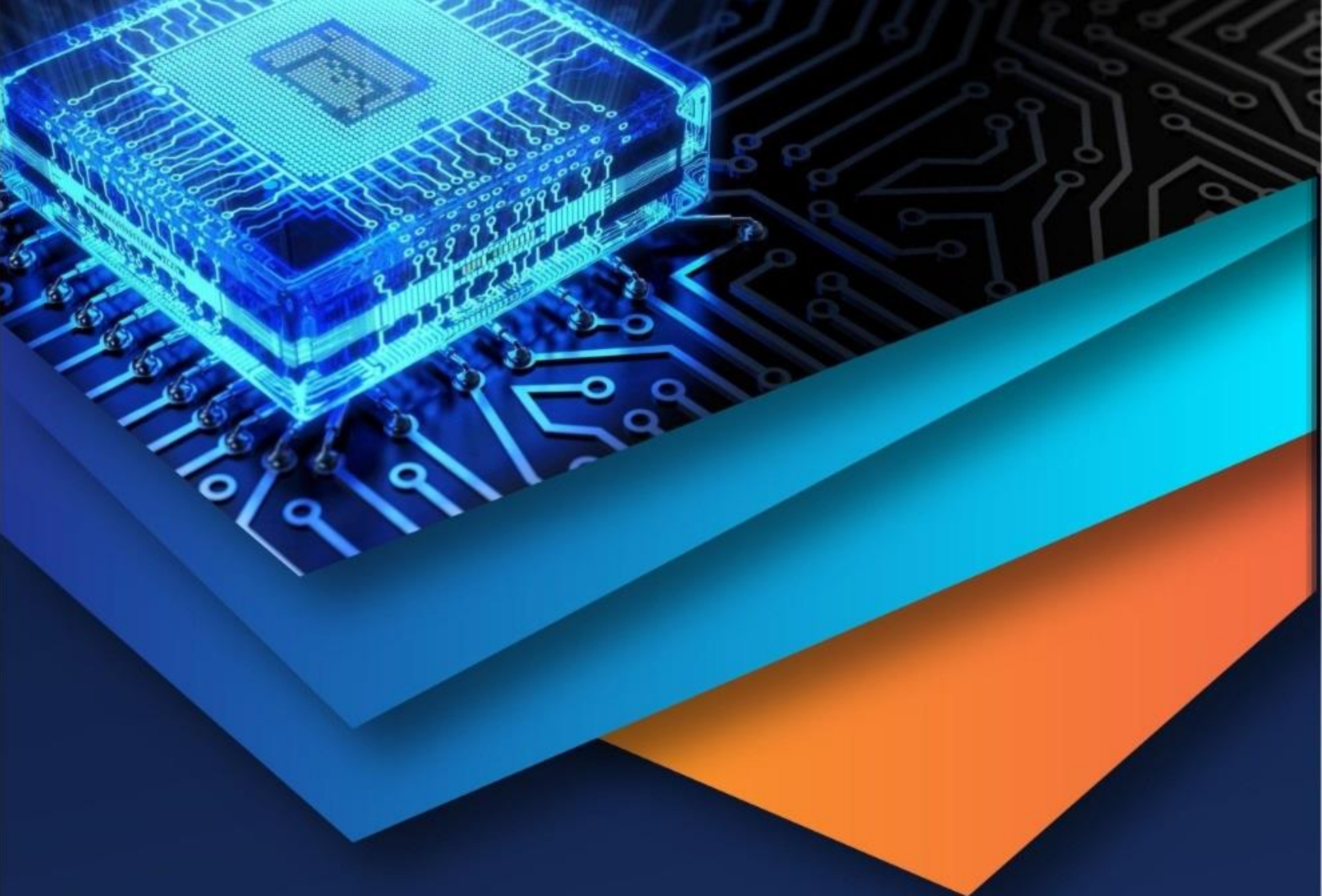
a) FLIR and Thermal imaging cameras have been acquired on suggestion to determine and pinpoint the heat losses and radiation emitting from the induction furnace.
b) Energy Meter calibration was done to eliminate the errors in meter reading.
c) Requisition has been put forth to acquire rectifier transformer with better efficiency.
d) Data is gathered for consumption of energy and furnace activity regularly as a result of the positive findings of the detailed study to further monitor the furnace activity.

V. CONCLUSION

The detailed study of furnace no 1,2,3,4 at Tube plant at Specialty Department of Graphite India Ltd was done to identify the energy losses occurring in the furnace. Insulation was changed of all the four furnaces citing heat loss as a major factor for the loss. Meters measuring the DC and AC power was calibrated. After the change of insulation, the energy meter reading and furnace energy consumption reading was taken and the difference was reduced and was found to be under allowed level.

REFERENCES

[1] "Power Electronics Devices, circuits, and Industrial applications",by V.R. Moorthi, Oxford University Press.
[2] "Thyristorised Power controllers",by Dubey, Donalda, Joshi,Sinha, Wiely Eastern New Delhi.
[3] "Power Electronics Applied to Industrial Systems and Transports, Volume 2, 2015" by Nicolas Patin.
[4] Doi.org/10.1016/j.energy.2017.07.121: "Energy losses from the furnace chamber walls during heating and heat treatment of heavy forgings"



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