# OPTIMIZATION OF SPECIFIC HEATING CONSUMPTION OF COKE OVEN PLANT USING FLOW METER CALIBRATION MODIFICATION

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## ABSTRACT

*Coke oven plant produces coke which acts as a reducing agent in blast furnaces. So, coke is an important material which is also called as a reducing agent. Coke is basically used for manufacturing of steel materials and extraction of metals. In an integrated steel plant coke is a prime material for making high grade of steels. In this present research work, the calibration of flow meter is modified. By this modification of gas flow meter calibration coke oven gas flow reduced from 17100Nm3/hrs to 16900Nm3/hrs, such as 200 Nm3 on hourly basis saving without any extra manpower cost. The proposed method is also cost effective as it saves Rs 6483000 every month for producing coke. This methodology is also helpful for reducing the manufacturing cost of coke in a recovery type of coke plant and stable oven operation and prolongation of coke oven life. Future advancements in this technique will allow us to minimize the need for money, which will revolutionize the nation's economy.*

## KEYWORDS

*Coke, Coke furnaces, heating chambers, heating flues, coke rate*

## PAPER INDEX




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# ABBREVIATION

**Table 1.** Technical type Abbreviation of coke plant.

| Serial No. | Code | Full form |
|---|---|---|
| 01 | C.P.D | Coke making duration in hr. |
| 02 | N1 | No. of ovens |
| 03 | N | No. of pushing target / charging target in a day |
| 04 | C.W.T | Cross chamber wall temperature |
| 05 | V | Gas Flow required in $Nm^3/h$ |
| 06 | C.O.G | Coke oven gas |
| 07 | C.V | Calorific value of coke oven gas in $kcal/Nm^3$ |
| 08 | Q | The Specific heat energy consumption in kcal/kg |
| 09 | T | Periods of Gas flow in hr |
| 10 | W.B.A.D | Weekly basis the average technical data |
| 11 | N.P.C.P.D | No. of pushing and charging in a day |
| 12 | S.H.C | Specific heating consumption of COG |
| 13 | A.S.H.C | Average of specific heating consumption in (kcal/kg) |
| 14 | H.W.F.N | Heating chamber wall flue No. |
| 15 | P.T | Pause heating time in sec. |
| 16 | T.H.W.N | Temperature of the chamber heating wall No. |
| 17 | W | dry basis charged coking coal in tones |

# 1. INTRODUCTION

Coke is produced by the proper destructive distillation of coal in coke plant. Specially feeding coal blend comprising of the various different types of blended coals of desired coking parameters is heated in an oxygen-free atmosphere (coked) until the most volatile components in the coal are removed. The process is carried out in battery, which contains twenty or more tall, wide and narrow ovens arranged side by side. In [1] this paper during carbonization coal passes through a softening phase when the coal particles swell and become soft. This soft mass is termed as metaphase and said to be plastic in nature. During this transformational phase coal releases most of its hydrocarbons, heavy oils and tar; the coal particles coalesce and are bound together by the plastic mass. On further heating the plastic mass re-solidifies into a porous mass called semi-coke. On further heating the semi-coke contracts and becomes a structurally stable product which we know as metallurgical coke or simply coke. In [2] the main function of by product plant to purified the raw coke oven gas. The step by step procedure of purification is little complicated. Firstly coke oven gas goes to primary gas cooler then coke oven Gas enters into the electric type tar precipitator from its bottom, via the gas distribution plate gas is uniformly distributed onto the whole section, then flows through high voltage electric field of the


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honeycomb upward to leave electric tar precipitator and enters into the exhauster unit. At the upper part of hydrogen sulfide scrubber, hydrogen sulfide in gas is absorbed with enriched ammonia water from ammonia scrubbing and lean solution from de-acidifier and ammonia stripping unit. At the same time of hydrogen sulfide removal in hydrogen sulfide scrubber, also carbon die oxide, hydrocarbons and ammonia are absorbed. Because the absorption process of hydrogen sulfide, CO2, hydrocarbons and ammonia is the process of exothermic reaction, therefore both upper stage and lower stage of hydrogen sulfide scrubber are provided with the coolers for hydrogen sulfide circulating scrubbing solution. In [3] the primary purpose of coke ovens is to transform coal into coke, which is utilized in the blast furnace as a fuel and reducing agent. The entire process of creating coke is fraught with safety risks, such as being hit by or tangled in moving machinery, getting burned, starting a fire or explosion, falling and slipping, being exposed to dust, noise, heat, and gas, etc. The majority of health risks associated with coke production is caused by emissions produced during coal charging, coal carbonization, coke pushing, and coke cooling. Poly nuclear aromatic hydrocarbons, which cause cancer, are present in coke oven emissions along with other hazardous materials. In [4] this article of research developed a new model for the reducing of variation in the burning of coal to coke during the coke making process and to gain the good quality and also to proper develop the energy in coke plant. The total length of the battery is hundred meters, consist of the rectangular type of shaped heating chambers of length sixteen meters, the height is seven meters, and the width 0.41 meters with removal door ends.[5]. In [6] this research paper describes gas pressure in the oven chambers should be positive and higher than pressure at any point of adjacent heating chamber during whole coking period. In [7] a new design of optimum control of temperature of gas coming out of the oven into the stand pipe is about 600-700 °C, and it leaves the hydraulic mains at the temperature of 80-85°C [8].In [9] in this system of ovens, paired vertical flues are envisaged which are interconnected with each other with a provision for recirculation of products of combustion. The heating chamber is divided into pairs of vertical flues. Vertical flues of each pair are connected at the top through a window in the partition wall [10]. In [11] coke oven gas can save 300-400 Nm3/hour by using reversal cycle modification in coke plant [12]. The gas and preheated air are fed to the base of the flues from where they move upwards under the influence of chimney draught.[13]the hot products of combustion cross over to the adjacent flues and pass on the regenerators where the checker-work absorbs most of the sensible heat contained in the product of combustion.[14]. In this paper, the cooled gases from the regenerator move to the waste heat flues and then to the chimney. These two currents of heat flow, i.e. the up-current and down-current are periodically reversed in every 20 minutes to maintain uniform and state temperature condition throughout the whole battery[15]. Readiness of coke at the end of coking period along the length, height and width of coke oven chamber by maintain uniform temperature throughout the length and height of heating wall all along the battery[16].The practical study was to determine in which of the several type alternative toxic air pollution abatement systems which affords the most economical solution to the control of at- morphemic emissions during the charging of coal into the by-product coke plant[17]BF Coke size


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is an important factor for blast furnace of operation. The Some type of methodology has been investigated in order to rectify the coke mean size.[18]. this paper, various types of elementary of reaction which having the different steps important for coke formation during thermal-cracking of the hydro- carbons are to be studied[19]. The papers describes, by the petro-graphic specific technique and the semi type coking coals or the non coking of coals to be blended and with coking coals is used to produce BF coke.[20].

However, a there is a requirement to follow a study to reduce the specific heating consumption by rectification of flow meter calibration in coke oven plant oven. Generally in running coke oven plant calibration of flow meter in yearly or half yearly which includes accuracy of flow of coke oven gas is not correct.

The main objective of the present research work is, to reduce the SHC by rectification of flow meter calibration instead of yearly to monthly in own plant lab in coke oven plant. The modification of flow meter is also helpful to reduce the carbon emission which is eco-friendly to the environment.

## 2. METHODOLOGY OF RESEARCH

The carbon deposits on coke oven walls may not only interrupt the oven operation. But also cause damage to the oven walls, although many studies have been made on the properties of deposited carbons and the mechanism of their formation. There are few on the quantitative emission of carbon formation in an actual coke oven. For the purpose of stable oven operation and prolongation of oven life, it is necessary to remove carbon according to the amount of carbon deposited on coke oven walls. A flow meter is aspecial type of instrument which is used to measure the flow rate of a gas then display the flow-reading to the instrument user via an indicator, digital analogue or the digital type output. The Calibration of the flow meter can be achieved in one of several ways, but generally involves the comparison of the flow meter against a reference standard of higher accuracy. Calibration is an essential part of an instrumentation system to ensure a line of traceability of the measurement system is maintained. To understand the flow meter performance over a period of time, flow meter calibration should always be conducted on “as Found” on the practical basis so meter drift- analysis can be assessed. With the further customer agreement, a further adjustment of the flow meter reading maybe performed to optimize the flow- meter errors.

In this paper, it is introduced that a quantitative emission of carbon formation rate on the wall was developed and new type SOP for regular maintenance, to optimize the SHC by modification of flow meter calibration instead of yearly to monthly in own plant lab in coke oven plant. The modification of flow meter is also helpful to reduce the carbon emission which is eco-friendly to the environment. This method is also helpful for the reducing of coke oven gas flow.


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## 2.1. SEVEN METER TALL BATTERY EXPERIMENTAL DESCRIPTION

The experimental set up for 7-meter-tall coke oven battery required some technical process and operation parameters which are shown in table1 which is given below. There are sixty seven number of heating oven, sixty eight number of heating wall and sixty nine numbers of waste heated boxes for transferring the waste gas tunnel to chimney. There are three number of charging hole for feeding the coking coal into the heating oven. Thirty-two tones of blended dried coal is charge per oven and output coke is around twenty five tones is produced. There are total thirty two number of heating flues out of thirty two sixteen numbers of heating flues in pusher side and sixteen numbers in coke side. The experimental brief description is given below in tabulation form in Table2.

**Table 2.** Technical parameters for experimental set up.

| No. of oven | No. of heating walls | No. of waste heat boxes | Dry charged coal in tones | No. of heating flues in pusher side | No. of heating flues in coke side | No. of heating flues per wall | Output coke per oven | No. of charging hole per oven | Oven height in meter |
|---|---|---|---|---|---|---|---|---|---|
| 67 | 68 | 69 | 32 | 16 | 16 | 32 | 25 | 03 | 7 |

## 2.2. CPD OF RECOVERY TYPE OF COKE PLANT

2.2 describe mathematical formula for time of coking period

$$\mathrm{CPD} = \frac{N_1 \times 24}{N}$$

## 2.3. NO. OF CHARGING / PUSHING IN A DAY

2.3 describe the advance mathematical expression for determining the No. of production target like pushing and charging schedule.

$$N = \frac{N_1 \times 24}{\mathrm{CPD}}$$

## 2.4. COKE OVEN GAS FLOW REQUIREMENT OF COKE OVEN GAS FLOW ACCORDING TO PUSHING AND CHARGING

2.4 comprise that mathematical equation for calculating the required flow of coke oven gas

$$V = \frac{Q*1000*N*W}{C.V \times T}$$


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## 2.5. CALCULATION FORMULA OF SPECIFIC HEATING CONSUMPTION OF COKE OVEN GAS

2.5 describe the mathematical equation formula for evaluating specific heating gas

$$Q = \frac{V*CV*T}{W*1000*N}$$

This type mathematical expression for calculating in the table 3, table 4 and table 5 respectively.

It was observed that the accuracy of flow of coke oven gas is more on yearly or half yearly calibration of flow meter. Due to this, flow meter is allowing to pass extra gases for producing the combustion process without the recovery of the sensible heat. To establish the reasons for the low efficiency, the calibration method of gas flow meter have suggested. The modification of gas flow meter calibration on monthly basis with respect to pushing and the charging and the possible modification type solution is verified against the Standard Operating Practices and preventive and daily Schedule jobs of Regular Maintenance). Technical data like number of pushing/charging per day is 83 and pause time 20 second is used obtaining values express in table 3.

**Table3.** S.H.C before modification of flow meter calibration.

| S/No. | W.B.A.D | A.S.H.C | N.P.C.P.D | P.T | C.P.D |
|---|---|---|---|---|---|
| 1 | 1 | 670 | 83 | 20 | 19.37 |
| 2 | 2 | 670 | 83 | 20 | 19.37 |
| 3 | 3 | 670 | 83 | 25 | 19.37 |
| 4 | 4 | 670 | 83 | 25 | 19.37 |
| 5 | 5 | 670 | 83 | 20 | 19.37 |
| 6 | 6 | 670 | 83 | 20 | 19.37 |
| 7 | 7 | 670 | 83 | 15 | 18.37 |
| 8 | 8 | 670 | 83 | 15 | 19.37 |
| 9 | 9 | 670 | 83 | 20 | 19.37 |

Table3 describes before modification of gas flow meter calibration coking periods is around 19.37 hours, pause time average is around 20 second at constant production target is 83.The average COG flow required in average pushing/charging 83 is 17100 Nm3/hr at above pushing/charging schedule. The all data is taken as on weekly basis which is mentioned in table 3.


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# 3. RESULTS WITH FULL DISCUSSION

## 3.1. MODIFICATION OF GAS FLOW METER CALIBRATION IN RESPECT OF PUSHING/CHARGING

It was observed that the accuracy of flow of coke oven gas is more on yearly or half yearly calibration of flow meter. Due to this, flow meter is allowing to pass extra gases for producing the combustion process without the recovery of the sensible heat. To establish the reasons for the low efficiency, the calibration method of gas flow meter has suggested. The modification of gas flow meter calibration on monthly basis with respect to pushing/charging and the possible rectification solution is verified against the Standard Operating Practices and Schedule jobs of Regular Maintenance). Due to additional gas consumption in coke plant at same pushing charging schedule of 83, the coke oven gas flow is reduced 200 Nm3/hr without affecting the coke quality.

**Table 4.** S.H.C after modification of flow meter calibration.

| S/No. | W.B.A.D | A.S.H.C | N.P.C.P.D | P.T | C.P.D |
|---|---|---|---|---|---|
| 01 | 1 | 660 | 83 | 20 | 19.37 |
| 02 | 2 | 660 | 83 | 20 | 19.37 |
| 03 | 3 | 660 | 83 | 25 | 19.37 |
| 04 | 4 | 660 | 83 | 25 | 19.37 |
| 05 | 5 | 660 | 83 | 20 | 19.37 |
| 06 | 6 | 660 | 83 | 20 | 19.37 |
| 07 | 7 | 660 | 83 | 15 | 18.37 |
| 08 | 8 | 660 | 83 | 15 | 19.37 |
| 09 | 9 | 660 | 83 | 20 | 19.37 |

Table4 describes after modification of gas flow meter calibration coking periods is around 19.37 hours, pause time average is around 20 second at constant production target is 83. The average on the before modification COG flow rate requirement in average pushing and charging 83 is 17100 Nm3/hr as per above pushing and charging target. The all data is taken as on weekly basis which is mentioned in table 3. After the medication of gas flow meter calibration, The average COG flow rate requirement in 83 numbers pushing and charging is 16900 Nm3/hr as per above pushing and charging schedule, which is given in the table 4.Afterthe modification of the COG flow meter calibration, to the thermal regime of coke oven plant at randomly at a time, the temperature of cross wall is taken at 05 numbers of heating walls. The temperature of Cross wall is the all heating wall of the flue (means of the all the 32 no. of heating flues) temperature recorded reading. The temperature of cross-wall data of reading is express in table 4, 16, 17, 18, 19, and 20, respectively.


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**Table 5.** CWT average cross wall reading in a day basis.

| HWFN | T.H.W.N (16) | T.H.W.N (17) | T.H.W.N (18) | T.H.W.N (19) | T.H.W.N (20) |
|---|---|---|---|---|---|
| 01 | 1170°c | 1170°c | 1180°c | 1180°c | 1170°c |
| 02 | 1170°c | 1180°c | 1180°c | 1180°c | 1180°c |
| 03 | 1180°c | 1190°c | 1180°c | 1190°c | 1180°c |
| 04 | 1190°c | 1190°c | 1190°c | 1200°c | 1190°c |
| 05 | 1210°c | 1200°c | 1200°c | 1200°c | 1200°c |
| 06 | 1210°c | 1210°c | 1210°c | 1210°c | 1210°c |
| 07 | 1220°c | 1220°c | 1220°c | 1220°c | 1220°c |
| 08 | 1230°c | 1230°c | 1230°c | 1230°c | 1230°c |
| 09 | 1220°c | 1220°c | 1220°c | 1220°c | 1220°c |
| 10 | 1220°c | 1220°c | 1220°c | 1220°c | 1220°c |
| 11 | 1230°c | 1220°c | 1230°c | 1220°c | 1230°c |
| 12 | 1220°c | 1230°c | 1220°c | 1220°c | 1230°c |
| 13 | 1230°c | 1230°c | 1230°c | 1230°c | 1230°c |
| 14 | 1230°c | 1230°c | 1230°c | 1230°c | 1230°c |
| 15 | 1230°c | 1230°c | 1230°c | 1230°c | 1240°c |
| 16 | 1220°c | 1220°c | 1220°c | 1220°c | 1220°c |
| 17 | 1220°c | 1220°c | 1220°c | 1220°c | 1220°c |
| 18 | 1220°c | 1220°c | 1220°c | 1220°c | 1220°c |
| 19 | 1240°c | 1240°c | 1240°c | 1240°c | 1240°c |
| 20 | 1250°c | 1250°c | 1240°c | 1250°c | 1250°c |
| 21 | 1240°c | 1240°c | 1240°c | 1230°c | 1240°c |
| 22 | 1250°c | 1250°c | 1250°c | 1250°c | 1250°c |
| 23 | 1240°c | 1240°c | 1240°c | 1240°c | 1240°c |
| 24 | 1250°c | 1250°c | 1250°c | 1250°c | 1240°c |
| 25 | 1250°c | 1250°c | 1240°c | 1240°c | 1250°c |
| 26 | 1240°c | 1240°c | 1240°c | 1230°c | 1230°c |
| 27 | 1230°c | 1230°c | 1230°c | 1220°c | 1220°c |
| 28 | 1220°c | 1220°c | 1220°c | 1200°c | 1210°c |
| 29 | 1210°c | 1210°c | 1200°c | 1210°c | 1210°c |
| 30 | 1200°c | 1200°c | 1190°c | 1200°c | 1200°c |
| 31 | 1190°c | 1190°c | 1190°c | 1190°c | 1190°c |
| 32 | 1180°c | 1180°c | 1180°c | 1190°c | 1180°c |

The table number 05 describes that the temperature cross wall average data of reading is taken in shift wise such as A, B and C shifts respectively. This represents, after the modification of COG flow, the thermal section of the coke plant is not more affected. The temperature of cross wall is taken in different schedule of shifts like A, B


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and C, in different of timing. Comparing the table3 and the table4, it is observed that after modification of the coke oven gas flow meter calibration, 200 Nm3/hr coke oven gas flow is saved. This is beneficial in terms of expenditure.

Figure 1 to 5 shows that the cross-wall temps taken at the different times and different of shifts do not affect the temp of flues. The randomly taken 5 No. ofwall, the cross wall temp is almost same in nature.

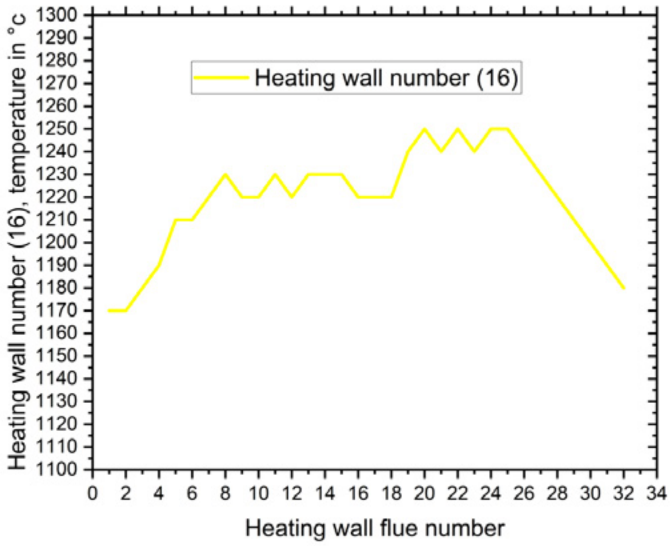


**Figure 1.** Variation of temperature for heating wall/flue number.

Figure1 comprises that the heating wall no. sixteen in x axis flue number and y axis temperature reading is taken. flue number 01 temperature is 1170 °c, flue number 02 temperature is 1170 °c, flue number 03 temperature is 1180 °c, flue number 04temperature is 1190 °c, flue number 05 temperature is 1210 °c, these temperature reading shows that temperature is slowly increases with respect to flue wise, the maximum temperature reading is taken in flue no.20 is 1250 °c. The last five numbers of flues temperature reading such as flue number 28 is 1220 °c, flue number 29 is 1210 °c, flue number 30 is 1200 °c, flue number 31 is 1190 °c, flue number 32 is 1180 °c.


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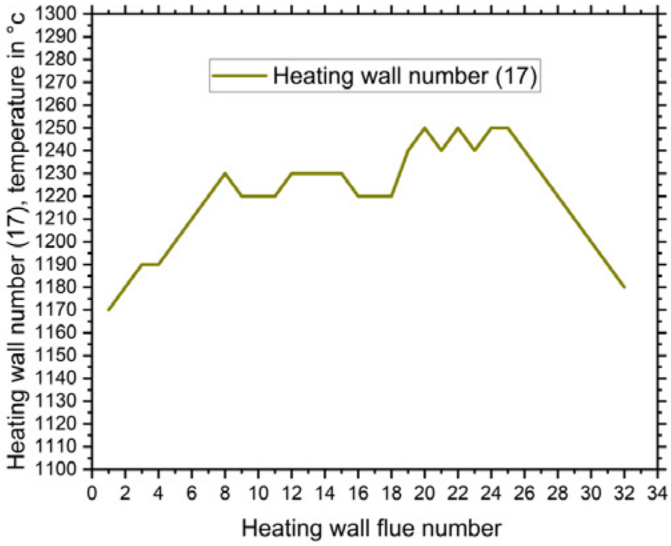


**Figure 2.** Variation of temperature for heating wall/flue number.

Figure2 comprises that the heating wall no. seventeen, in x axis flue number and y axis temperature reading is taken. flue number 01 temperature is 1170 °c, flue number 02 temperature is 1180 °c, flue number 03 temperature is 1190 °c, flue number 04temperature is 1190 °c, flue number 05 temperature is 1200 °c, these temperature reading shows that temperature is slowly increases with respect to flue wise, the maximum temperature reading is taken in flue no.20 is 1250 °c. The last five numbers of flues temperature reading such as flue number 28 is 1220 °c, flue number 29 is 1210 °c, flue number 30 is 1200 °c, flue number 31 is 1190 °c, flue number 32 is 1180 °c.

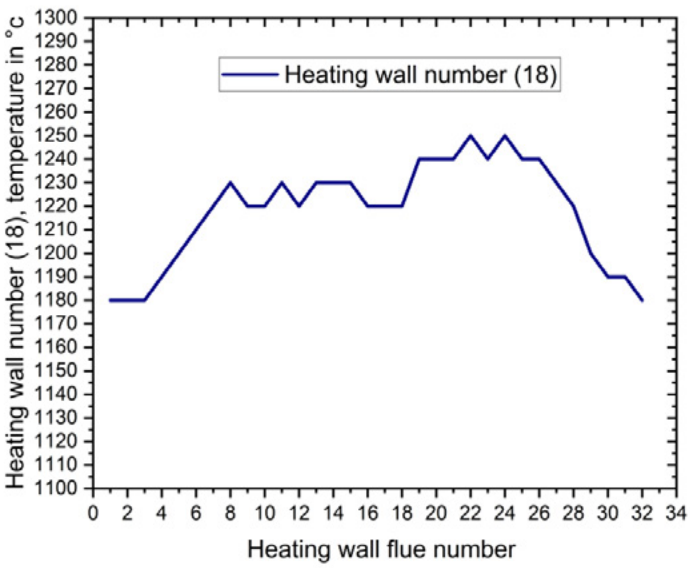


**Figure 3.** Variation of temperature for heating wall/flue number.

Figure3 comprises that the heating wall no. eighteen, in x axis flue number and y axis temperature reading is taken. flue number 01 temperature is 1180 °c, flue number


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02 temperature is 1180 °c, flue number 03 temperature is 1180 °c, flue number 04temperature is 1190 °c, flue number 05 temperature is 1200 °c, these temperature reading shows that temperature is slowly increases with respect to flue wise, the maximum temperature reading is taken in flue no.22 is 1250 °c. The last five numbers of flues temperature reading such as flue number 28 is 1220 °c, flue number 29 is 1200 °c, flue number 30 is 1190 °c, flue number 31 is 1190 °c, flue number 32 is 1180 °c.

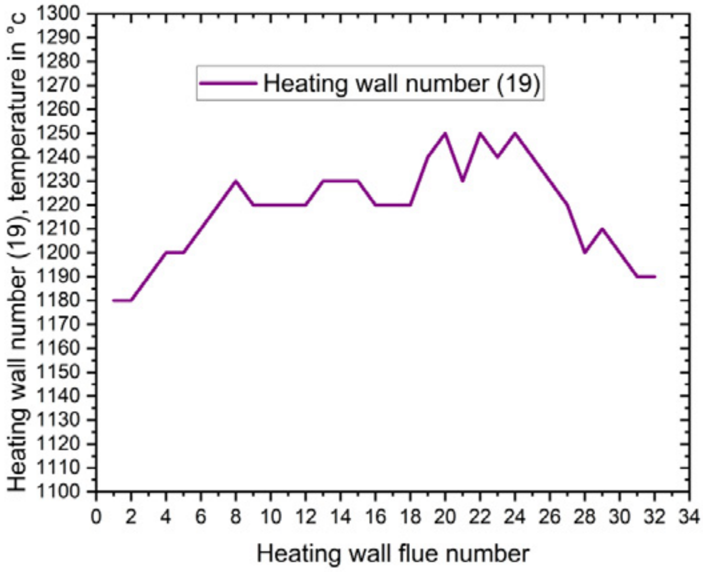


**Figure 4.** Variation of temperature for heating wall/flue number.

Figure4 comprises that the heating wall no. nineteen, in x axis flue number and y axis temperature reading is taken. flue number 01 temperature is 1180 °c, flue number 02 temperature is 1180 °c, flue number 03 temperature is 1190 °c, flue number 04temperature is 1200 °c, flue number 05 temperature is 1200 °c, these temperature reading shows that temperature is slowly increases with respect to flue wise, the maximum temperature reading is taken in flue no.20 is 1250 °c. The last five numbers of flues temperature reading such as flue number 28 is 1220 °c, flue number 29 is 1210 °c, flue number 30 is 1200 °c, flue number 31 is 1190 °c, flue number 32 is 1190 °c.


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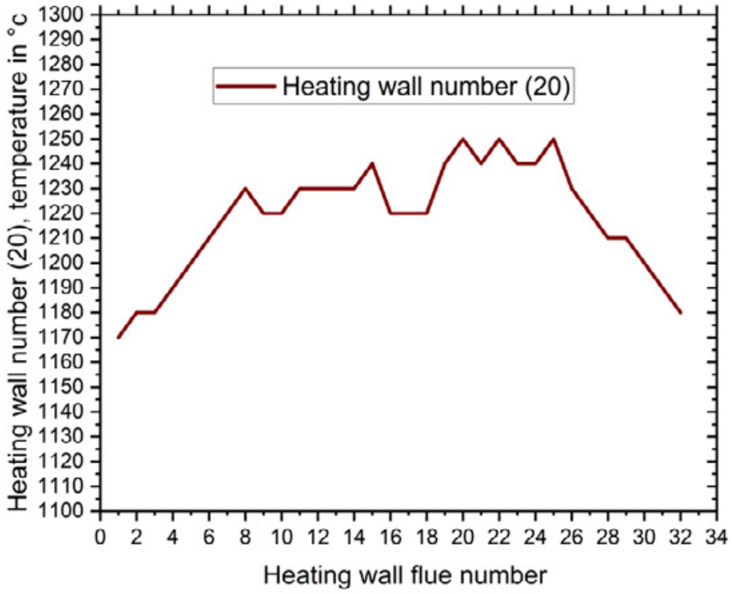


**Figure 5.** Variation of temperature for heating wall/flue number.

Figure5 comprises that the heating wall no. twenty, in x axis flue number and y axis temperature reading is taken. flue number 01 temperature is 1170 °c, flue number 02 temperature is 1180 °c, flue number 03 temperature is 1180 °c, flue number 04temperature is 1190 °c, flue number 05 temperature is 1200 °c, these temperature reading shows that temperature is slowly increases with respect to flue wise, the maximum temperature reading is taken in flue no.20 is 1250 °c. The last five numbers of flues temperature reading such as flue number 28 is 1210 °c, flue number 29 is 1210 °c, flue number 30 is 1200 °c, flue number 31 is 1190 °c, flue number 32 is 1180 °c.

**Table 6.** -Comparison analysis of hot strength of coke.

| Serial no. | Weekly basis average data | Before modification CSR value | After modification CSR value | Before modification CRI value | After modification CSI value | Before modification gas flow ($Nm^3/hr$) | Before modification gas flow ($Nm^3/hr$) |
|---|---|---|---|---|---|---|---|
| 01 | First week | 63 | 63 | 23 | 23 | 17100 | 16900 |
| 02 | Second week | 63 | 63 | 23 | 23 | 17100 | 16900 |
| 03 | Third week | 63 | 63 | 23 | 23 | 17100 | 16900 |
| 04 | $4^{th}$week | 63 | 63 | 23 | 23 | 17100 | 16900 |
| 05 | $5^{th}$week | 63 | 63 | 23 | 23 | 17100 | 16900 |
| 06 | $6^{th}$ week | 63 | 63 | 23 | 23 | 17100 | 16900 |
| 07 | $7^{th}$ week | 63 | 63 | 23 | 23 | 17100 | 16900 |
| 08 | $8^{th}$ week | 63 | 63 | 23 | 23 | 17100 | 16900 |
| 09 | $9^{th}$ week | 63 | 63 | 23 | 23 | 17100 | 16900 |


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Table 6 describes that the hot strength of coke quality, the lab report is taken on daily basis then after it is taken the average value of weekly basis. The lab report is same as on the modification of gas flow meter. Before modification coke strength after reaction(CSR) value is 63 and after modification coke strength after reaction (CSR) value is almost same as 63. Before modification coke reactive index (CRI) value is 23 and after modification coke reactive index (CRI) value is almost same as 23.by the modification of gas flow meter calibration, coke oven gas is saved up to 200 Nm3 onhourly basis.

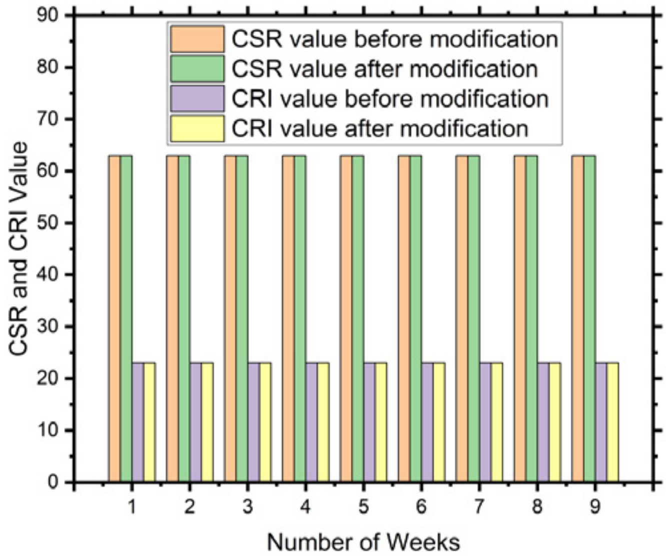


**Figure 6.** comparative analysis of CSR and CRI Value before and after modification.

Figure 6 describes that the comparative analysis of hot strength of coke quality like CSR and CRI, the lab report is taken on daily basis then after it is taken the average value of weekly basis. The lab report is same as on the modification of gas flow meter. Before modification coke strength after reaction (CSR) value is 63 and after modification coke strength after reaction (CSR) value is almost same as 63. Before modification coke reactive index (CRI) value is 23 and after modification coke reactive index (CRI) value is almost same as 23.by the modification of gas flow meter calibration, coke oven gas is saved up to 200 Nm3 onhourly basis. The saving of coke oven gas which is shown in figure 7.

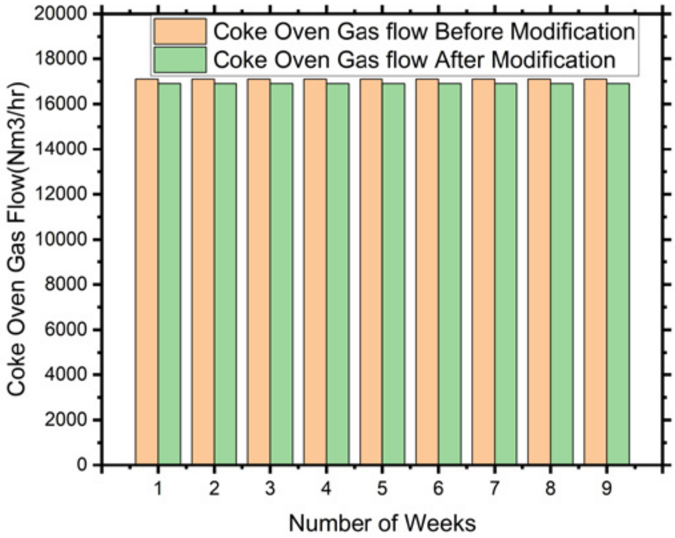


**Figure 7.** comparative analysis of coke oven gas flow before and after modification

Figure 7 comprises that the comparative analysis of coke oven gas flow before and after modification of gas flow meter. Firstly requirement of coke oven gas flow is about 17100 Nm3/hrs then after rectification gas flow requirement is about 16900 Nm3/hrs. This shows that 200 Nm3/hrs coke oven gas is saving in hourly basis. On the saving of coke oven gas by the modification of gas flow meter calibration the coke quality is not change, quality of coke like CSR and CRI value remains constant.

**Table 7.** -Comparison analysis tabulation of SHC.

| Sr. No. | A.S.H.C (kcal/kg) before rectification | A.S.H.C (kcal/ kg) After the rectification | Saving of COG ($Nm^3/hr$) | COG saving on monthly basis($Nm^3$) | Monthly Saving of the COG @ 4.5 rupees/$Nm^3$ |
|---|---|---|---|---|---|
| 01 | 670 | 660 | 200 | 144000 | 648000 |

Table 7 shows that before and after modification of gas flow meter calibration SHC value reduced from 670 to 660in kcal/kg. The modified COG flow (with the respect of pushing and charging), the average saving in COG is 200 Nm3/hour. This will reduce the production cost of coke.


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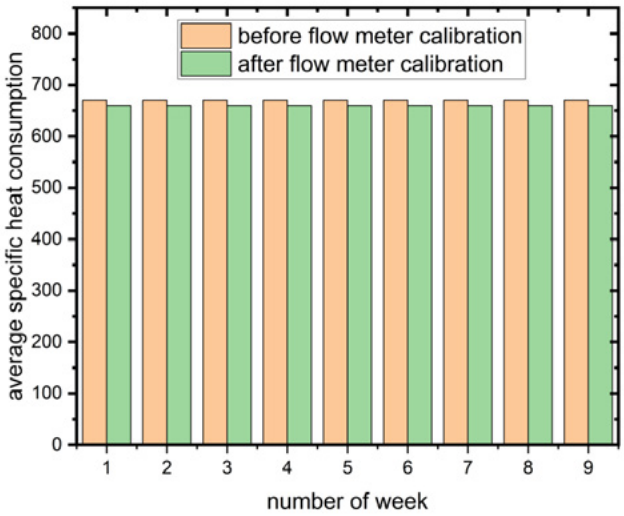


**Figure 8.** comparative analysis between before and after calibration of flow meter

Figure 8 comprises that the experimental value of specific heat consumption with respect to number of weeks. Specific heat consumption is directly proportional to the gas flow requirement. Firstly requirement of coke oven gas flow is about 17100 Nm3/hrs then after rectification gas flow requirement is about 16900 Nm3/hrs. This shows that 200 Nm3/hrs coke oven gas is saving in hourly basis. After the rectification of smoke pushing specific heat consumption value is reduces from 670kcal/kg to 660kcal/kg which is given in table 6.

# 4. CONCLUSION

By this modification of gas flow meter calibration coke oven gas flow reduced from 17100Nm3/hrs to 16900Nm3/hrs, such as 200 Nm3 on hourly basis saving without any extra manpower cost. The proposed method is also cost effective as it saves Rs 6483000 every month for producing coke. This methodology is also helpful for reducing the manufacturing cost of coke in a recovery type of coke plant and stable oven operation and prolongation of coke oven life. Future advancements in this technique will allow us to minimize the need for money, which will revolutionize the nation's economy.

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