A Review on Normalising Furnace Fuel Replacement

Sanu Kumar Choudhary[1]

[1] *Engineering Student, Mechanical, G H Raisoni College of Engineering, Maharashtra, India*

ABSTRACT

Aim of this paper is to Replace Normalising Furnace fuel, provide remedies and by providing alternate better fuel. Normalising furnace has to work 24x7, lots of fuel are used every second who lead to various pollutions and high economy cost. So an alternate fuel can be used. The aim of the training was to study the overall operations and processes carried out in manufacturing of Rail Wheels, understand various operation processes involved in their manufacturing, develop own skills in the field of Manufacturing, Marketing & Entrepreneurship and to develop myself as an Engineer and grow a Socially active business oriented mind.

Keyword: - *Normalising, Fuel, Furnace, Combustion, Bio diese.etc.l*

1. NORMALISING

Introduction:

The first process in heat treatment is normalizing. In normalizing the wheel I '4 is heated beyond the upper critical temperature (900-920 degree Celsius) and soaked at that temperature.
Normalising is basically a heat treatment process. Normalising furnace here consists of 7 zones out of which 3 zones are heating zones and 4 a zones are soaking zones. The heating and soaking zones are 45 minutes each. The wheels are loaded on each pedestal through the charging machine in either auto mode or manual mode.
In case of temperature variation beyond specified limits in heating zones, the operator shall get it rectified by the maintenance staff. The temperature is found to be 30 to 40 degree Celsius, above the upper critical temperature (940 to 950 degree Celsius).
Wheels offloaded before heat treatment due to any reasons are generally tackled on Sunday/holiday. After annual maintenance shutdown or major work on normalizing furnace when the furnace remains shut off, following pre-heating chart is followed while lighting up the furnace. It has been noted that the capacity of this furnace is to normalize about 70 wheels.
The main purpose of this furnace is to:
1. To relieve internal stresses due to non-uniformity in cooling between the surface and its centre due to the difference in the cooling rates between the sections of same casting.
2. To achieve chemical homogeneity.
3. To achieve desired mechanical properties such as toughness, hardness, ductility, tensile strength, stiffness.
4. To refine the grain size of that particular wheel
5. To improve machinability.

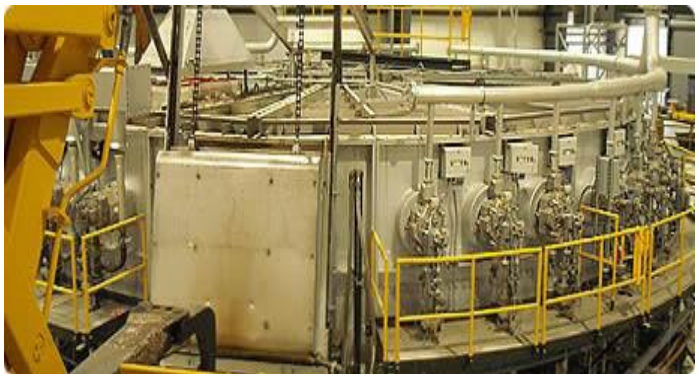


Fig -1: Normalising furnace

1.1 PROCESS

1. The diesel used as fuel for RHF is stored in external tanks. This is pumped to another secondary tank near the furnace. This secondary tank has safety mechanisms to ensure that the tank does not overflow.
2. From this tank the diesel is pumped to the individual nozzles.
3. Air required for atomizing and combustion is pumped using electric motors and air pumps. This air is then supplied to the burner units.
4. The atomizing air atomizes the HSD being supplied. The combustion air then mixes with the diesel and then the diesel spontaneously combusts as it enters the furnace.
5. This burning diesel provides the heat to maintain required furnace temperature.
6. Once the furnace attains required temperature cast wheels are loaded into the normalising furnace using a water cooled forklift type arm mechanism.
7. After each cast wheel is loaded, the RHF rotates every 1.5 minutes to take in a new wheel.
8. After the wheel completes a full rotation in RHF it is removed using similar arm mechanism. A wheel is removed from the furnace every 1.5 mins**.**

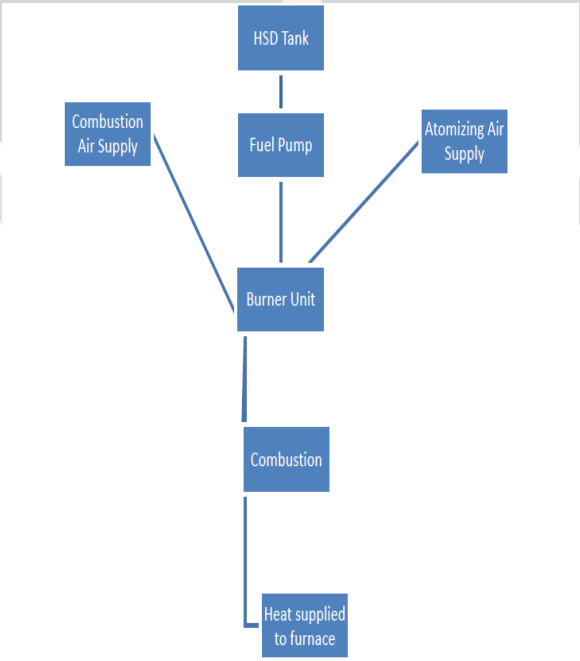


Fig -2: Flow chart

1.2 NORMALISING FURNACE AT RWF

RWF uses a Rotary Hearth Furnace for the normalising process of wheels. The picture below is that of a Rotary Hearth Furnace. The rotary hearth furnace is a continuous furnace concept that allows processing of small to very large product. The material is conveyed directly on the furnace hearth which consists of an externally driven turntable located inside the furnace heating chamber. Furnaces can be provided in electric, direct fired and indirect gas fired configurations to meet specific processing requirements. The furnace design can be configured with diameters exceeding 80 feet.

The specifications for the RHF used for Normalising at RWF are as follows:

- The normalizing furnace used in RWF uses High Speed Diesel as its fuel.
- There are 7 zones in the normalizing furnace. Zones 1-3 are heating zones and zones 4-7 are soaking zones.
- The normalizing furnace has a capacity of 60 wheels in 90 minutes which is 1.5 min. per wheel on average.
- There are 62 burner units around the normalizing surface. Each burner has one nozzle which has 4 orifices which atomizes and sprays the fuel.
- The burner units also have two separate air supply pipes, one is the atomizing air and the other is combustion air. The atomizing air atomizes the fuel and the combustion air is used to burn the fuel completely.
- The fuel combusts spontaneously in the furnace due to the high temperature. The normalizing furnace uses around 13500 to 15000 litres of fuel per day.
- Entry of the wheels is at roughly 260C. The discharge wheel temperature is at 950C.
- The drive of the normalizing surface is Chain Drive Roller Conveyor. Compressed air is supplied by a 75HP motor.
- The normalizing furnace is subjected to peripheral cooling by supplying water.
- The furnace lining is of ceramic modules which can withstand a maximum temperature of 1260C while the floor of the furnace is made of 4 to 5layers of brick and can withstand a maximum temperature of 1300C.

2. BIODIESEL BLENDS

Blends of biodiesel and conventional hydrocarbon-based diesel are products most commonly distributed for use in the retail diesel fuel marketplace. Much of the world uses a system known as the "B" factor to state the amount of biodiesel in any fuel mix:

- 100% biodiesel is referred to as B100
- 20% biodiesel, 80% petrodiesel is labeled B20
- 5% biodiesel, 95% petrodiesel is labeled B5
- 2% biodiesel, 98% petrodiesel is labeled B2

Blends of 20% biodiesel and lower can be used in diesel equipment with no, or only minor modifications, although certain manufacturers do not extend warranty coverage if equipment is damaged by these blends. The B6 to B20 blends are covered by the ASTM D7467 specification. Biodiesel can also be used in its pure form (B100), but may require certain engine modifications to avoid maintenance and performance problems.

Blending B100 with petroleum diesel may be accomplished by:

- Mixing in tanks at manufacturing point prior to delivery to tanker truck
- Splash mixing in the tanker truck (adding specific percentages of biodiesel and petroleum diesel)
- In-line mixing, two components arrive at tanker truck simultaneously.
- Metered pump mixing, petroleum diesel and biodiesel meters are set to X total volume, transfer pump pulls from two points and mix is complete on leaving pump.

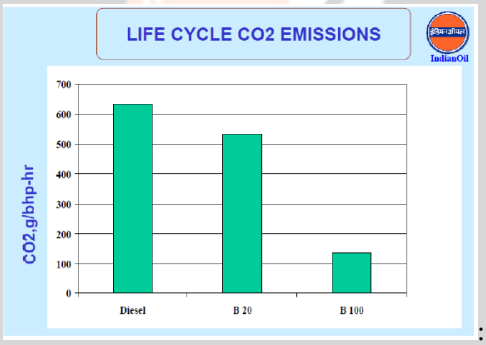
2.1 PROPERTIES

Biodiesel has promising lubricating properties and cetane ratings compared to low sulfur diesel fuels. Depending on the engine, this might include high pressure injection pumps, pump injectors (also called unit injectors) and fuel injectors.

The calorific value of biodiesel is about 37.27 MJ/kg. This is 9% lower than regular Number 2 petrodiesel. Variations in biodiesel energy density are more dependent on the feedstock used than the production process. Still, these variations are less than for petrodiesel. It has been claimed biodiesel gives better lubricity and more complete combustion thus increasing the engine energy output and partially compensating for the higher energy density of petrodiesel.

The color of biodiesel ranges from golden and dark brown, depending on the production method. It is slightly miscible with water, has a high boiling point and low vapor pressure. *The flash point of biodiesel (>130 °C, >266 °F) is significantly higher than that of petroleum diesel (64 °C, 147 °F) or gasoline (−45 °C, -52 °F). Biodiesel has a density of ~ 0.88 g/cm³, higher than petrodiesel (~ 0.85 g/cm³).

Biodiesel contains virtually no sulfur, and it is often used as an additive to Ultra-Low Sulfur Diesel (ULSD) fuel to aid with lubrication, as the sulfur compounds in petrodiesel provide much of the lubricity.



:

Chart -1 LIFE CYCLE CO_2 EMISSIONS

.

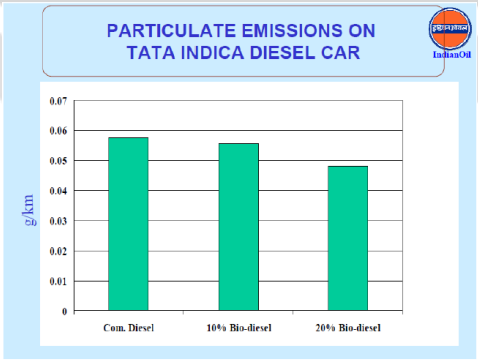


Chart -2 Emission On Tata Indica Diesel Car

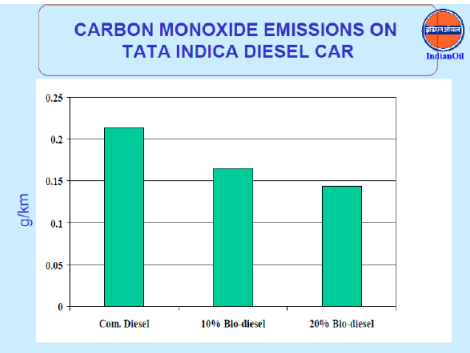


Chart -3 CO Emission On Tata Indica Diesel Car

2.2 REMEDIES

Sl. no.	Physical properties.	Petro-diesel IS: 1460:2000	Bio-diesel as per ASTM D 6751
1.	Fuel composition.	Hydrocarbons	Fatty acid of methyl esters.
2.	Kinematic Viscosity @ 40° C in cst	2.0 to 5.	1.9 to 6.
3.	Flash point ° C	35° C Min	130° C
4.	Sulphur, % mass	0.25 max	0.05 Max
5	Cetane number	45Min	47 min
6.	Cloud point.	Lower than bio diesel	Higher than petro-diesel
7.	Pour Point	3° C for winter 15° C for summer	
8.	Oxygen %	Almost negligible.	Up to 11% free oxygen.
9.	Carbon %	87(low sulphur diesel	77
10.	Sulfur	< 1.2 (low sulphur diesel)	None
11.	Lubricity	Low	High
12.	Material Compatibility	Degrades Natural rubber.	No effect.

3. ECONOMIC ANALYSIS

The cost of Bio-diesel production depends on the following factors:

- Seed production & collection from the farmers.
- Quality of Vegetable oil
- Availability of the raw materials.
- Crushing
- Esterification.
- Chemical used
- Man power.
- Resell value of the by-products

The cost of Bio-diesel can be reduced if we consider non –edible oils such as Karanja, Jatropha, neem, mahua etc, which are available in India specially in Jharkhand & Bihar and some other states also. After analysis (Rs 5/kg seeds) the cost of production from the small scale Bio-diesel reactor, it was found that Karanja based bio-diesel were found to be Rs 20 to 25/- per litre which is much less than the existing cost of the Diesel per litre excluding the cost of reduced emissions, Expenditure related to health, hazard and other benefit obtained while analysis the oilcake, employment etc.
Therefore considering inflation and other economic factors let us assume;
The price of B100% Bio Diesel is Rs.40 per litre.
The current market price of Petro Diesel is Rs.73.46 per litre**.**
Considering the fuel to be used as a B20% blended type fuel which contains 20% Bio Diesel and 80% Petro Diesel.
Considering the prices above the price of B20 blended type diesel would be about Rs.60.768.

4. CONCLUSIONS

Rail Wheel Factory has continuously strived to meet international environmental standards since its inception and has also been conferred with the ISO 14001 certification. As part of our internship program we have conducted a basic study to look into the possibility of implementing environmentally friendly measures at the plant according to the ISO 14001 guidelines. Our proposal is to replace the use of HSD as fuel in the normalising furnace with biodiesel. We suggest that, the factory should look into the use of blended or pure biodiesel as fuel in the normalising furnace. The use of blended biodiesel with B6-B20 specifications require no modifications to the existing set up and hence would be a ready solution to reduce pollution and also cost of fuel could be reduced by almost as much as 2.5 Crores as cost of biodiesel is much lower than petro diesel. Pure Biodiesel can also be used as fuel but that would require further detailed study of the furnace system.

Therefore, we would like to suggest that as part of the Environmental Management System that has been set up at the factory to look into the possibility of substituting HSD with Biodiesel with respect to the fuel being used to burn in the normalising furnace of the wheel shop.

5. ACKNOWLEDGEMENT

A summer internship is a golden opportunity for learning and self-development. I consider myself very lucky and honoured to have so many wonderful people lead me through the completion of my summer internship.
My grateful thanks to Mr. Arbind Kumar, principal TTC and Secretary to CAO for providing me with this opportunity to undertake an internship/Project program at RWP, BELA (SARAN).
I would also like to thank Mr. Satyendra in spite of being extraordinarily busy with his duties, took time to hear, guide and keep me on the correct path. We would not know where we would have been without him.
Last but not least, we would like to thank the staff of RWP, BELA (SARAN) who shared valuable information that helped in the successful completion of this project.
And my college guide Dr. A K Mahalle for his efforts and his excellent ideas and helping me out in releasing this paper. Thank you

6. REFERENCES

[1]. www.indianrailways.gov.in

[2]. www.metallography.com/types.htm

[3]. Pollution and noise in steelworks from electric arc furnaces – Commission of European Communities

[4]. www.wikipedia.org

[5]. Material Science and Metallurgy by O P Khanna.

[6]. Elements of Workshop Technology by S K H Choudhury, A K H Choudhury & Nirijhar Joy.

[7]. Indian oil.

BIOGRAPHIES

	Mechanical Engineer Student from G H Raisoni College of Engineering Nagpur.