Automatic Gas fired furnace

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Abstract
The essence of any Foundry is its furnace. The operation of the furnace legally involves the process of melting metal by hand is highly dependent on human performance as well ability. With increasing demand and improved technology, this is a common approach it is quickly replaced by temperature-controlled libraries. Basic the effectiveness of such a control to compare the temperature of the metal with the set melting temperature and send the corresponding output to the heat or heat feature. The type of temperature and the furnace customize the type of controller used. While such a control system exists, other safety and fuel management controls plans are the essentials of a modern day oven. This paper is intended in the construction of such a gas burner control system. Gas exploded Furnace Control System includes an active Burner Management System a large part of the melting process. The Control system is built with emphasis on Flame Feedback method, which was analyzed in detail. The control system is actually a temperature control system which includes sensor inputs including thermocouple and flame rod, and effects such as large gas valve, heat rod and blower fan motor. Thus this system is aimed at proper burner management that facilitates the furnace operation and ensures safety of not only the furnace-burner system but the plant in general.

Keywords: Gas Fired Furnace, Burner Control System, Flame Feedback

1. Introduction
Foundry Technology is the heart of any metal-based industry. In that sense, almost every industry in the world depends on the Foundries. On the other hand, the Foundation itself,
however, relies on furnaces that do not only dissolve metals, but are used as a general heating element. Traditional Foundries did not have an automatic temperature control system and this created many inefficiencies and unsafe conditions for the plant and staff at the base. The skill and experience of the worker was a major factor affecting the efficiency of the furnace. However, a Control System designed for Gas Fired Furnace overcomes these errors with automatic temperature control and a burner control system. Temperature control ensures reduced losses due to high temperature of the metal.

One of the biggest problems facing foundry workers is the heat. In the gas furnace control system this issue is referred to the heating coil control circuit. Safety is also a very important factor in preventing leaks, using a flame-retardant circuit to ensure that the flame is turned on or off and thus controls the large gas valve on or off. Finally, the system also shows the shape of the furnace with 2 LED display boards separately for Metal Temperature and Crucible Temperature. Despite this, there are other indicators such as Power on, Relay on, etc. and handbob backup manual for blower on and burner on. It therefore provides a more sensitive feature of the furnace’s performance.

A heater is a device used to burn fuel with gasoline to convert the chemical energy of gasoline into thermal energy. A given fire system may have one or more heaters depending on the size and type of application. There are two types of burner designs: cylindrical balls and rectangles. Cylindrical geometry has some limitations regarding the size and type of load, which is suitable for specific applications such as aluminum or cement clinker melting. The most common heating system has more heat in a rectangular geometry. This type of system is very difficult to analyze due to the large number of heat sources and interactions between fires and the fire products associated with them. There are many aspects to the manufacture of burners. These factors affect factors such as heat transfer and emission. The traditional designs used in burners have undergone many changes, mainly due to the recent interest in reducing emissions. In the past, burner designers were primarily concerned with heating fuel and transferring energy to hot loads. New regulations and stricter environmental laws have added to the need to take emissions into account. In many cases, reducing emissions and increasing fire efficiency are mutually exclusive. The choice of fuel has a significant effect on heat transfer from fires. In most cases, the choice of fuel as part of the system specification is defined by the customer and is not selected by the burner manufacturer. Whatever is chosen, the designer must do his part. In most cases, the heating is designed according to the choice of fuel [1].

A cross-linked regulator is also included to control the amount of air fuel. Open air is tested with the axial flame axis of different air pressures as well as temperatures and flame values. From the experiments, the highest recorded temperatures were 488.1, 688.8 960.3 and 1275 C for gas pressures of 0.53, 1.02,1.53 and 1.7 bar respectively 30, 60, 90 and 100% [2].

The function of the flame sensor is to tell the controller that the main gas burners are burning. If no flame is present after a certain period of time, the regulator needs to take appropriate measures, first of all to close the gas valves in high temperatures.
When two electrodes are placed side by side in a flame and when connected to an ac power source, the current ac will move. Flame retention occurs because the flame itself is ionized. The finest and heaviest particles in a flame, called ions, are attracted to a non-electrode. Solar and ligamous particles in the sun, called electrons, are attracted to a fine electrode. This system can be used to sense flames, by making two electrodes uneven. If one electrode is at least four times larger than the other, the current in both parts of the sine will not be equal. This is due to differences in mobility due to the size and weight of the good and bad particles [3].

Many foundries use coal as a major source of fossil fuels environmental pollution. Last year, about 6.6 billion tonnes of solid coal and 1 billion tonnes of brown coal were used. Since 2000, worldwide coal consumption has grown faster than other fuels. The production philosophy to eliminate the use of heaters that require coal and electricity power consumption in the region (AP).

Deliberate efforts have been made to reduce coke consumption by replacing coal with oil and oil. As part of a fuel-fired fire project is designed and built. For this purpose others Preliminary melting and processing is performed using Aluminum alloy melting after the design of the original test adjustments made to reduce heat loss. Finally A mixed fuel furnace running in coke and diesel melting oil of ferrous alloys is successfully applied to the latter This furnace can work effectively used as a furnace at the base [6].

2. Methodology and components used
The main idea is to improve the gas-fired control system to avoid accidents with heat failure, flame safety and especially to control the furnace. This temperature system is enhanced with temperature control using a printed circuit board. Therefore, the project aims for automatic furnace control and heating control due to the safety controls mentioned above. It also determines the efficiency of the furnace, considering one of the contributing factors such as the width of the fuel orifice.

2.1 Burner Control System
The Burner management system, requires the following electronic and electrical equipment, as described below.

Thermocouple:
Thermocouple sensors are used to measure temperature. Thermocouples have two wire legs made of different metals. The legs of the ropes are tied to one side and a junction is formed. This is where the temperature is measured. When faced with a change in road temperature, voltage is generated. Electrical energy can be translated using thermocouple reference tables to calculate temperature.

In terms of temperature, durability, vibration resistance, chemical resistance and application compatibility, there are many types of thermocouples with their own unique characteristics. The most common types of J, K, T and E type thermocouples with "base
metal" thermocouple. R, S and B types of thermocouples are "noble metal" thermocouples used in high temperature applications.

Type Thermocouple (Nickel-Chromium / Constantan): Type E is a very strong signal and has a higher density than Type K or a temperature less than 1,000 K and less than Type J. Type E is much more stable than K, which increases its accuracy. Type E Temperature range: Thermocouple grade wire, -454 to 1600 F (-270 to 870 C). Extension cord, temperature range: 32 to 392 F (0 to 200 C). Type accuracy (whichever is larger):

- Average: +/- 1.7°C or +/- 0.5%
- Special Error Limits: +/- 1.0°C or 0.4%

Consideration of empty E thermocouple type instruments:

- In oxidizing or inert atmospheres the operating range is approximately -418°F to 1,652°F (−250°C to 900°C).

Flame rod:

Flame detection systems have two basic principles - flame operation and flame correction. Most operating systems are not used. This type of system depends on the efficiency of the flame when electrical energy is applied to the 2 electrodes in the flame. Flames combine with other electrons to exit the atoms between the electrodes and produce ions. This is called flame ionization.

Well-charged ions flow to a well-charged electrode and badly charged electrons flow to a well-charged electrode. At 60 Hz, it changes its polarity 120 times per second. At the same time, one of the electrodes lights up, and turns negative after 1/120 second. When the voltage changes, the direction of the current flame (ion current) changes. In the operating system, the regions of the 2 electrodes (flame and ground electrodes) are the same and the flame flow between them is the same in both directions. This is the principle of the operating system.

When the AC voltage is applied from the flame electrode to the ground electrode, alternating current flows and the force applied by the flame. Due to the current flame AC in the steering system, the system does not distinguish between leakage current and current flame current. The system incorrectly indicates the presence of flame (with harmful effects) if the flame electrode enters the ground through the leak circuit with the same resistance as the leak retardant. The carbon deposit at the base of the flame electrode can create a highly efficient leakage system and a false flame indicator. (Validates the direct reduction system of low impedance.)
The flame repair system uses 2 electrodes, but with one significant difference - the ground electrode is always designed to be much larger than the flame electrode (wire flame). For this to work properly, the ground electrode area must be at least four times larger than the flame rod. Typically, the ground electrodes are hot beads. Due to the difference in electrode size, more than one current flows from one side to the other. The current on one side is much larger than the current on the other, which means that the current effect is the direct driving force acting on the electronic network. The transmission of flames indicates the presence of heat and allows the order of the flames to continue. The larger the area of the electrode flame, the greater the current flow in the right direction - in other words, the adjusted current. A single ionized method with flame and various electrodes can provide the current adjustment required for the maintenance of electronic networks in the correction system. When a leak occurs a high ground resistance occurs in the flame field, which sends the AC signal to the network and the system closes securely. The repair program distinguishes between high leakage resistance and the presence of flame. Current flame is measured by a microamp. Standard microorganisms range from 2 to 10.

Flame detector Cable specifications:
Due to the low power of the flame nerve, precautionary measures should be taken to monitor the potential for exposure to the flame detection system. The following are a few steps to follow to get the best results: The cable length should be as short as possible. Typical cable lengths are between 30 and 60 meters. If longer strings are fully required follow this suggestion: Use Ultraviolet sensors as they are less sensitive to cable length. Cable lengths between 90 and 120 meters can be tolerated without causing problems. Cable lengths over 300 meters are not
uncommon. Therefore, for more than 300 meters run, in-line and temperature performance tests should be performed as the first part to begin to ensure the effectiveness of the flame detection system.

The cables should be inside the channels and be as far away as possible from other cables and power lines. The conduits should be metal and sterilized according to the proper standards. If there are multiple lines of sight it is best not to combine all indicators within a single channel. It is best to use more than one route. A single wire cable should be used as it has very high power protection properties and low power. Any leakage method can affect the current ionization. Heat protection and protection cable should be used. Cable size does not matter. However, only one wire, 18 gauge and large wire cord must be used in accordance with the rules of flame sensors. Protected cables are not recommended and multi-stranded telephone wires should not be used. Conversion conversion can affect flame detection. Therefore, the high voltage transformer cables on the spark plug or spark electrode should be as short as possible. Sparks electrodes should be placed as far away from the flame rods as possible. The two circuits must be independent. Changing the connection on the main side of the temperature converter can help. This is especially true when ionization decreases during heating. Systems that use a single electrode (uni-rod) for ignition and detection do not have this type of problem

Ignition rod:
A periodically controlled driver system uses electric propulsion to heat the gas driver and later to large heaters, when the thermostat wants to heat up. The heating system uses a computer-controlled heating element and not unlike a light bulb cable (also shown in the photo above), to heat a gas canister.

Gas Valve (Solenoid Valve):
Provide control of natural gas extraction, LP and gas emissions for drivers in industrial and commercial applications. Used magnetically, it is usually closed. Provide action as soon as you can. In the power reduction, the valve closes in one second. Apply in any position, directly to the pipeline or support brackets. Replace the solenoid coil without removing the valve body from the pipe connection. Straight-through valve pattern. Available in low voltage or low voltage models.

Figure 2. Gas Valve
2.2. Mathematical modeling

The burner is in the shape of a vent and consists of a port, larynx, mixing tube, bottom section and tip or nozzle, each of which plays a major role in the operation of the stove.

Burner heat release or burner output power is determined by the expression:

\[ HR = m \times HV \] 

Where, \( HR \) is the burner heat release, \( m \) is the mass flow rate of the fuel, and \( HV \) is the heating value of the fuel.

The fuel mass flow rate can be determined directly from fuel consumption of furnace (B).

\[ B = 16 \text{ kg/hr} \]
\[ m = \frac{B}{3600} = \frac{16}{3600} = 0.0044 \text{ kg/s} \]

Heating Value is taken as the Lower Heating Value (or net calorific value) of the fuel (vaporized Petroleum gas) as 465000 kJ/kg.

Substituting in the Heat release formula (1), we get

\[ HR = 0.0044 \times 46.5 \times 10^6 \text{ J/s} \]
\[ = 204.6 \times 10^6 \text{ J/s or 204.6 kW} \]

Furnace function Measurement of emissions used in a heat exchanger. The performance of the furnace is determined by direct and indirect methods. The capacity of the furnace measures the heat produced compared to what the fuel burns. The percentage of fuel that the furnace actually heats up is called the annual fuel consumption capacity (AFUE). The furnace is called underground, central or efficient. Effective models, less than 78% AFUE, are older and rarely sold. Effective models range from 78% to 90% AFUE. Anything beyond that level is considered high efficiency. In 1992, the US Department of Energy set a lower AFUE rate for a 78% new furnace.

The efficiency of the furnace can be calculated by measuring the amount of fuel consumed per unit weight of material produced from the furnace.

The heat supplied to the stock can be found from the formula

\[ Q = m \times C_p \times (t_2 - t_1) \]

Where:

\[ Q = \text{Quantity of heat in kCal} \]
\[ m = \text{Weight of the material in kg} = 300 \text{ kg Aluminium} \]
Cp = Mean specific heat, k Cal/kg C° = 0.22 k Cal/kg C° for Aluminium

\[ t_2 = \text{Final temperature desired, } C° = 800°C \]
\[ t_1 = \text{Initial temperature of the charge before it enters the furnace, } C° = 30°C \]

\[ Q = 300 \times 0.22 \times (800-30) \text{ k Cal} \]
\[ = 50820 \text{ kCal} \]

Therefore, Heat Output = 50820 kCal
Fuel Input = 16 kg/hr

Heat Input = 16 \times 10000 = 160000 kCal

Efficiency = \frac{\text{Heat Output}}{\text{Heat Input}} \times 100 \%
\[ = \frac{50820}{160000} \times 100 \%
\]
\[ = 31.76\% \]

3. Conclusion

The Gas Furnace Burner Control system works in such a way that the operation of the manual stove does not work. However, system control can be greatly improved than the current situation through the Distributed Control System (DCS) with SCADA. This can improve alertness, efficiency and complete bone control.

The Gas Furnace Control System is an independent banner management system that controls safety. Provides automatic control and secure operation. However, this program can be implemented using DCS and SCADA. In this way, a little oil can be controlled remotely.

Another feature to be added to the machine is the Human Machine Interface. Here, we will use the Programmable Logic Controller (PLC) to verify a dedicated Logic Solver. This will also improve speed, and reduce the need for transmission and PCBs, which further increases efficiency.
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