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Usage of Nitrogen gas in different sections of tube annealing furnace for creating internal atmosphere & improving material quality

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Abstract

Heat treating or annealing is the controlled heating and cooling of a material to achieve certain mechanical properties, such as hardness, strength and the reduction of residual stresses. Many heat treating processes require the precise control of temperature over the heating cycle, the energy used for process heating accounts for 2% to 15% of the total production cost. The objective of this work is to improve surface quality of MS-pipes and copper pipes and avoid, unwanted reaction such as oxidation, decarburization and reaction with residual lubricants can occur between the tube surface and the surrounding atmosphere.
Proper selection and control of the annealing atmosphere is critical to produce a bright, high equality surface, with the help of using endo gas and nitrogen gas in different sections with different parameters in the furnace .The research methodology was based on GMBH LOI annealing furnace based on both experimental work and theoretical developments including modeling on annealing furnace. The real time furnace parameters determine from the experimental data.

Keywords: Drivers, Usage of Nitrogen gases in different sections of Furnace.

1. Introduction

Metal tubes are annealed to increase their ductility making them easier to bend machine and form. In the annealing process, the metal is heated above a critical temperature then slowly cooled to room temp. to obtain a softer and less distorted material structure. At these processing temperatures , unwanted reaction such as oxidation, decarburization and reaction with residual lubricants can occur between the tube surface and the surrounding atm. Proper selection and control of the annealing atmosphere is critical to produce a bright, high equality surface . Heat treating is the controlled heating and cooling of a material to achieve certain mechanical properties, such as hardness, strength, flexibility, and the reduction of residual stresses. Many heat treating process Is require the precise control of temperature over the heating cycle. Heat treating is used extensively in metals production, and in the tempering and annealing of glass and ceramics products. Typically, the energy used for process heating accounts for 2% to15% of the total production cost.

The avoid oxidation and minimize safety risks, air must not enter the furnace either long the outside or entering through the inside of the tubing. In addition to keeping the opening as small as possible, flame or mechanical curtains can be used to restricted the air ingress. The atmosphere flow pattern should direct the atmosphere gases through the incoming tubes and purge the air, moisture and residual lubricant from the inner diameter and along the outer surface away from the furnace.

The main requirement on the furnace atmosphere is that it should be neutral with respect to the metal. three element oxygen (o), to eliminate oxidation, carbon (c), to eliminate decarburization of carbon steel.

The three element are present in the furnace atmosphere as the gas molecules oxygen (O_2), and nitrogen (N_2) but preferentially as atoms in other molecules like carbon monoxide (CO) water(H_2O) or carbon dioxide (CO_2)

A furnace atmosphere principally has two major parts, a neutral and an active gas.

2. **LITERATURE REVIEW**

The essence of this literature review is to understand reduce some disadvantages and improve atmosphere within time limits as well as brightness of material surface with respected to our flow parameters of nitrogen gases and endo gases. In al the cases, the manufacturer's recommendations should be followed for gas introduction, purging and removal since the original equipment manufacturer has taken these factor into account during the design of the equipment's.

National fire protection association(NFPA) standered 86, "standard for industrial furnace using a special processing atmosphere," applies to all furnace and the procedure listed within this standard must be followed. Furnace Atmosphere for tube annealing by R. Andersson, T Holm, T. Mahlo, S. Wiberg, Furnace Atmosphere Consideration for Fasteners by Richard D. Sisson, & Daniel H. Herring

Daniel H. Herring is president of HERRING GROUP, Inc. Elmhurst, IL while Richard D. Sisson, Jr. is George F. Fuller Professor and Director f Manufacturing Engineering, Mechanical Engineering Department, Worcester Polytechnic Institute, Worcester, MA, Herring, D.H., Understanding Furnace Atmospheres, Atmosphere Operation and Atmosphere Safety, Heat

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They recommended the future work for the project is the incorporation surface quality optimization routine. Such a routines enables the furnace utilization and improve furnace efficiency. Also model is specially developed to different process enable more gas reactions and also useful for process optimization. In this annealing furnace metal is heated at 930C for increase their ductility and bright surface quality.

3. Methods/approach

Research methodology is based on data collected through tube annealing furnace technology. Furnace idea is applied practically in industries and this is important for increasing brightness and material surface quality. The problem was selected from gap found in literature. The data is collected through Gandhi special tubes ltd. Halol, Gujarat, India. Data collection procedure is reliable because instrument available is accurate regarding the furnace or their internal atmosphere measurement. Furnace is running but taking more time to create internal environment when its restart or sometimes material is not perfect on same parameters so we have to change the parameter of nitrogen gas(-196°C) in different sections to reduce time and fasten the process.

4. Results and Discussion

The data is collected from Gandhi special tubes ltd. Halol Gujarat India. The LOI WESMAN furnace is used for that with dew point analyzer, oxygen analyze, internal gases for MESA software used for collecting data following result show:

4.1 Usage of Nitrogen gas

Applied nitrogen gas with different flow in three sections they are:

(a.) inlet zone
(b.) Heating zone
(c.) cooling zone

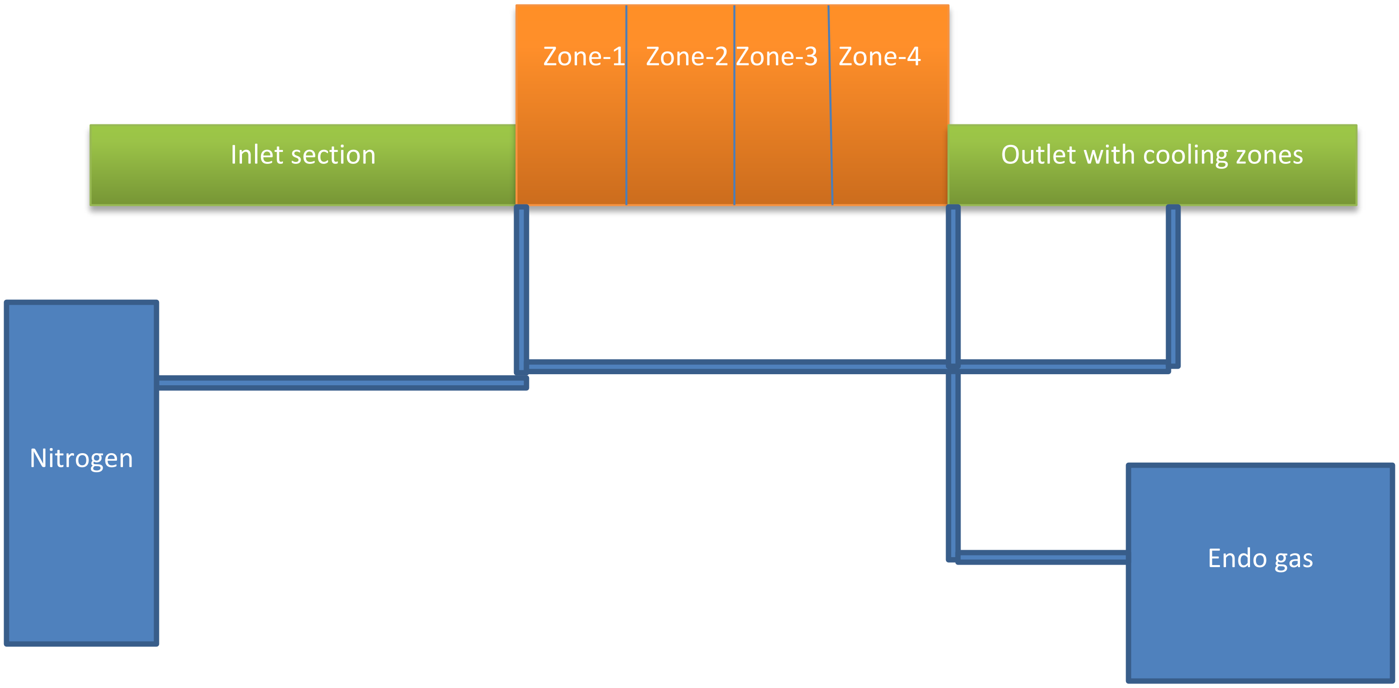

Fig.4.1.1 New invention in annealing furnace
This data is use for improvement

Nitrogen	**Flow(m^3/h)**
Inlet	70
Heating zone	160
Cooling zone	70
Total	300

Endo gas is flowing at 100 M^3/H

A "rule of thumb" to remember is that to purge air out of a furnace prior to introduction of combustible furnace atmosphere requires a minimum a five volume changes of the chamber (Table 3.3). This is to ensure that the oxygen content of the chamber is below 1% prior to the introduction of the atmosphere

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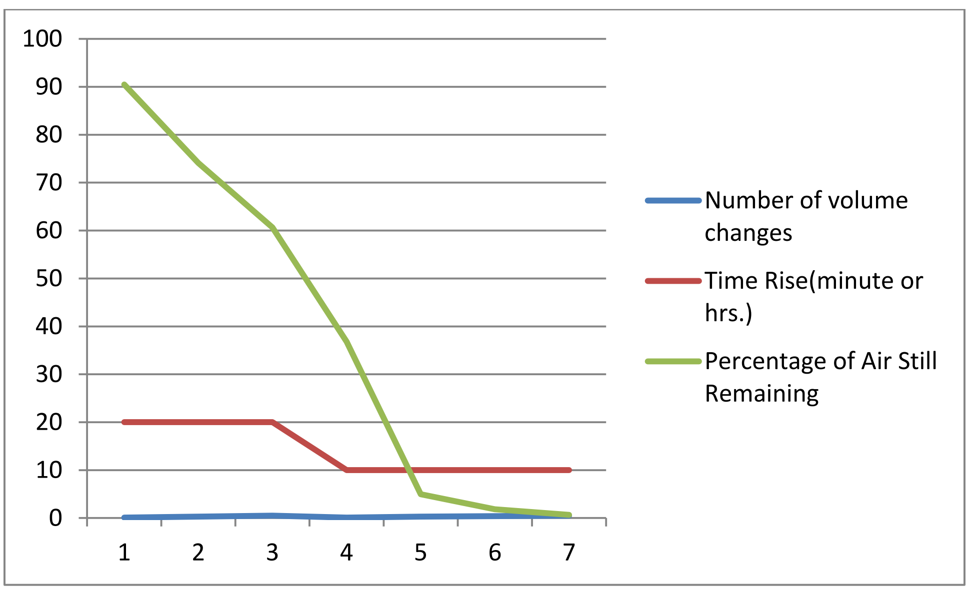
Table 4.1.1 Volume Changes Required for safe purging of furnaces with time

Number of volume changes	Time Rise(minute or hrs.)	Percentage of Air Still Remaining
0.1	20	90.48
0.3	20	74.08
0.5	20	60.65
0.1	10	36.79
0.3	10	4.98
0.4	10	1.83
0.5	10	0.67

Graph 4.1 Graph b/w time and air changes with respected to volume



4.2 Conclusion:

After applying we get some data, they are:

Table 4.2.1 Nitrogen Endo gas Atmosphere Field Data

Flow Data	**%N_2**	**%H_2**	**%CO_2**	**%CO**	**%CH_4**	**Dew Point,°C(°F)**
Nitrogen/Endogas With Natural Gas and Air Enrichment	40-48	40-45	0.6-1.4	12-16.1	7-11.2	0°C to +15 (+30 to +65)

In all the cases, the manufacturer's recommendations should be followed for gas introduction, purging and removal since the original equipment manufacturer has taken these factor into account during the design of the equipment's.

National fire protection association(NFPA) standard 86, "standard for industrial furnace using a special processing atmosphere," applies to all furnace and the procedure listed within this standard must be followed.

Table .4.2.2 Comparison of synthetic furnace atmospheres

Atmosphere	**Type**	**%H_2**	**%N_2**	**%CO**	**Dew Point,°C(°F)**
Hydrogen	Pure	100	0	0	-70 to -85 (-95 to -120)
Nitrogen	Blended	90	10	0	>-50(-50)
Endothermic	Generated	40	40	20	3 to -23 (+40 to -10)
Nitrogen-Endo	Blended	14	80	6	< 0
Nitrogen - Hydrogen	Blended	5-75	95-25	0	-51 (-60)

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Control Of Furnace Atmosphere

Good quality control must be ensured due to the fact that the composition of the furnace atmosphere constantly changing, so measurement and control devices must be used. In particulars, for atmospheres design to run "neutral", avoiding decarburization and/or carburization is critical to the proper functionality of the fastener. This is accomplished by making sure that one or several of the following control methods is monitoring and/or controlling the process:

- Dew point analyzers
- Oxygen (carbon) probe

Throughout the entire cycle it is critical to the process that we control the:

- Percentage of carbon dioxide, oxygen, and water vapor;
- Ratio of enriching gas (or air) to carries gas.

For example, surface carbon can be controlled within ±0.10 by measuring one or more of these constituents.

Dew point control

The temperature that water vapor starts to condense is known as the dew point. In the simplest terms then, a dew point analyzer measures the amount of water vapor present in atmosphere of the furnace in (Table 4.2.3). This information can be used to determine the carbon potential of the atmosphere . Its possible with technical instrument.

Table 4.2.3 Typical dew point levels

Dew point,°C(°F)	**Water vapor (ppm)**
+8 (+46)	10,590
-4 (+25)	4,320
-18 (0)	1,240
-40 (-40)	127
-68 (-90)	3.4

Note :
1% moisture = 127 ppm water vapor = +40°F dew point

Table 4.2.4 Dew point VS. surface carbon (%)

Dew point, °F(°C)	**815°C (1500°F)**	**870°C (1600°F)**	**925°C (1700°F)**
+30 (-1)	1.10	0.75	0.50
+40 (+4)	0.86	0.60	0.40
+50 (+10)	0.64	0.40	0.27

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If performed properly dew point analyzer is a simple and accurate measurement technique and indicates the condition inside the atmosphere generator or heat treat furnace. It will tell you if the reaction is stable or unstable . It can tell you when the catalyst bed in your endothermic gas generator is starting to soot and if there is a water leak, an air leak or non-uniformly ("breathing") of the atmosphere inside your furnace.

Different temperature with different zones.

Section	**Zone Temperature °C**
Zone-1	880
Zone-2	900
Zone-3	930
Zone-4	930

Table 4.2.5 Atmosphere equilibrium oxygen partial pressure, and corresponding CO_2/CO and H_2O/H_2 volume concentration to yield a bright surface and no decarburization. The concentration ratios are given for an atmosphere having 5 volume-% CO and 10 volume-% H_2.

Zones	**CO%**	**CO_2**	**CH_4**	**Carbon level**	**O_2 level**	**Dew point**
Zone-1	7.0%	0.065%	0.50%	0.08%	0.00	8.4
Zone-2	7.10%	0.071%	1.55%	0.19%	0.00	8.5
Cooling zone	7.0%	0.0.17%	2.10%	1.65%	0.00	8.5

When we are giving the inputs of nitrogen gas in different section of heating zones so oxygen level will be reduce with respect to time but when we are using flow according to above table reference so oxygen level or flue gas level will be reduce at exact time duration without any causes. When we are using nitrogen flow in different flow time will be reduces for creating furnace internal atmosphere.

After overall operation we are increasing quality of product and customer also need quality after they will decide cost of product so main motto of any industries is surface quality. when quality will be ok then cost of product will be automatically increase loss will be decrease.

Advantage

1. Oxygen level will be reduce within small time duration.
2. Time will be reduces of internal atmosphere generated.
3. Explosion(blasting) accident will be stop.
4. Quality of product will be good.
5. Remove flue gases from the furnace with the help of nitrogen pressure.

6. Reduce carbon level
7. Prevent firing at inlet or outlet curtains
8. After pressure generate inside of furnace we can detect external environment.

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