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सत्यमेव जयते

GUJCOST/2009-10/2195 **Date:** 8 SEP 2009

To,
Head (Technology Systems Division),
Department of Science & Technology,
Technology Bhavan,
New Mehrauli Road,
New Delhi - 110 016.

Sub: Technology for Dissemination

Dear Sir,

The group of faculty members under the leadership of Dr. N.S. Varandani from Dept. of Environmental Engineering, L.D. College of Engineering, Ahmedabad has developed Air Pollution Control System (APC) for reduction of pollution particularly SPM, SO_2, NO_2. The detail is attached herewith for your information. The inventors have already applied for the patent of the same. The design of the system and technology has been provided to some industries and it is successfully working in the industries. The technology seems to be very much useful for reduction of industrial pollution. So it is circulated for the purpose of the dissemination and further perusal at your end. Any further queries may be sent to the following email addresses, hodenv@hotmail.com and sciof-gujcost@gujarat.gov.in .

Thanking you,

With warm regards,

Dr. A.M. Prabhakar
Advisor & Member Secretary

Encl: As above
Copy to: (1) State S & T Councils
(2) Dr. N.S. Varandani

SAPO
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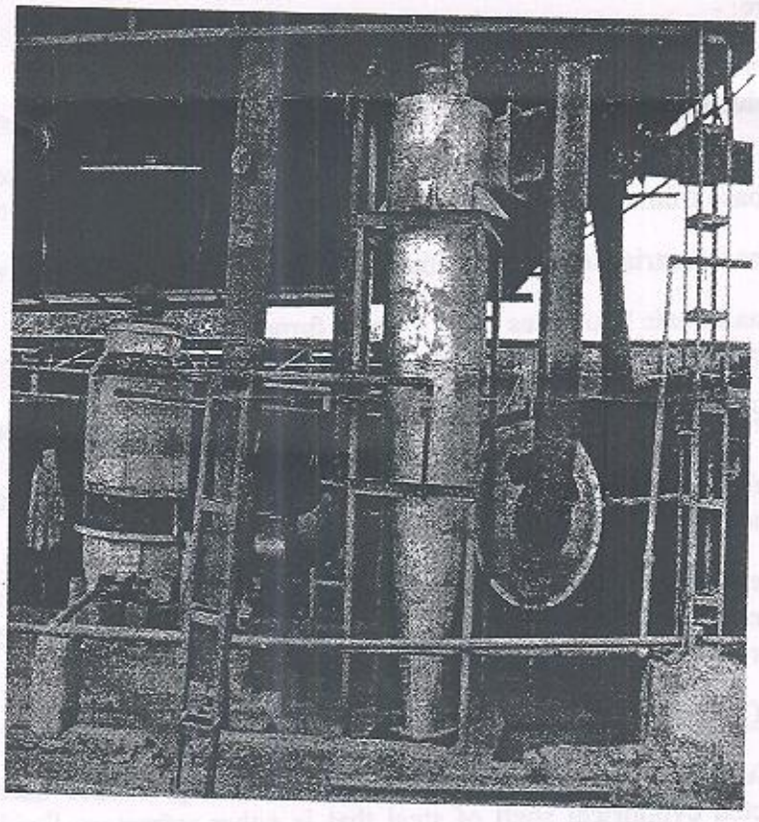
INTEGRATED AIR POLLUTION CONTROL SYSTEM



DEVELOPED BY:

Dept. of Environmental Engineering,

L.D. College of Engineering,

Ahmedabad.

THE TEAM:

Dr N S Varandani

Prof Y H Oza

Prof G H Ban

Prof Huma Syed

Prof Minarva Pandya

1. INTRODUCTION

Ahmedabad city was identified as the fourth most polluted city of India from the view point of air pollution as per the ranking developed by Central Pollution Control Board (CPCB) as part of its National Ambient Air Quality Monitoring Programme (NAAQMP). In order to address the air pollution problems of the major cities of India the Supreme Court appointed Environmental Pollution Control Authority (EPCA) in consultation with Gujarat Pollution Control Board (GPCB) under the chairmanship of Mr. Bhurelal.

EPCA & GPCB jointly identified the two most important major sectors contributing to Respirable Suspended Particulate Matter (RSPM) & Suspended Particulate Matter (SPM) as being the major culprits for deteriorated ambient air quality conditions. The two sectors identified were: -

i) Vehicular Traffic
ii) Industries

The problem of air pollution due to vehicular traffic has been solved by switching over the fuel base from conventional fuel to CNG for public transport system and autorickshaws.

The two major industrial sectors contributing to air pollution problems were identified as: -

i) Small Scale Foundries using Cupola furnace
ii) Textile process houses

In order to address the air pollution problems due to Cupola based foundries The Ahmedabad Engineering Manufacturing Association approached the department of Environmental Engineering of L.D. College of Engineering, Ahmedabad to study the problem and suggest the remedial measures.

The department accepted the challenge of identifying the problems and suggesting the engineering interventions in the present casting process as well as suggesting and designing appropriate air pollution device to satisfy air pollution norms.

2. THE CUPOLA FURNACE

The Cupola is the most common type of melting furnace used in foundries. It is a vertically erected cylindrical shell of steel that is either refractory lined or water cooled. The furnaces are classified by shell diameter ranging from 300 mm up to 3750 mm ID. A typical Cupola consists of three main sections:

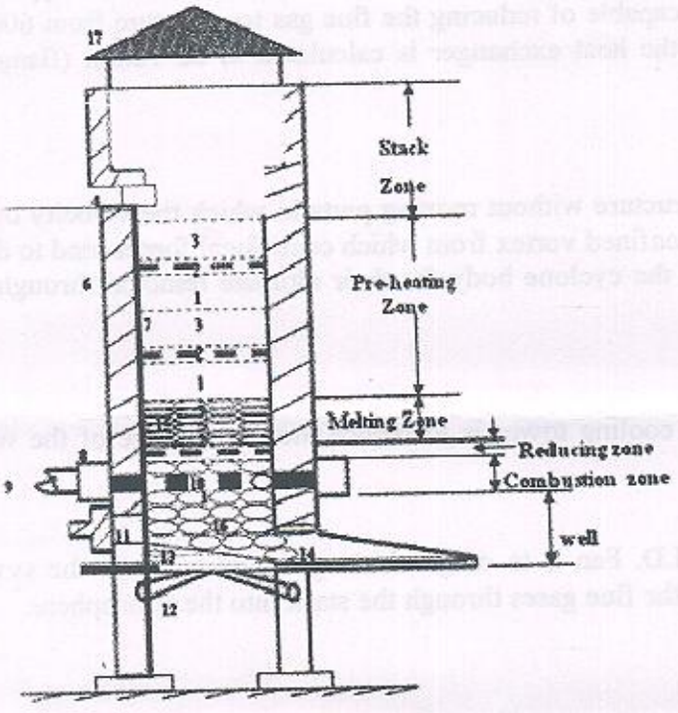
i) The well: It includes the bottom doors, the sand bottom and the tap hole.

ii) The melting zone: It consists of tuyeres that introduce the combustion air into the Cupola from the wind box surrounding the shell.

iii) The upper stack: - It is the portion from the melting zone towards the charging door and is connected to the air pollution control equipment.

Iron is melted in cupola by charging metals/ pig iron along with coke and limestone through a **charging door** or opening near the top. The heat from the burning coke melts the iron. The molten iron is collected from the bottom while the waste gases are emitted from the top of the cupola through the stack.

The present practice of operating the small scale foundries is to operate the furnace for 2 to 3 hours a day only.



1.	Coke
2.	Flux
3.	Metal
4.	Charging door
5.	Stage
6.	Steel Shell
7.	Refractory Lining
8.	Wind box
9.	Air blast inlet
10.	Tuyeres
11.	Fettling hole
12.	Drop bottom
13.	Sand bottom
14.	Tapping hole
15.	Metal charge
16.	Coke bed
17.	Spark Arrester

Figure – 1 Schematic Diagram of Cupola Furnace

3. EMISSION OF AIR POLLUTANTS

The air pollutants mainly carbon dioxide (CO_2), sulphur dioxide (SO_2) & particulate matter –PM (metallic oxides & coke ash) are primarily emitted through two outlets namely:

i) The charging door/hopper
ii) The stack

The present operating practice is such that lot of heat & dust along with gaseous pollutants is released through the charging door itself prior to getting emitted into the atmosphere through the small stack. This creates unhygienic, unhealthy & unbearable heat conditions for the operator & within the foundry premises. The pollutants emitted from the stack are responsible for deterioration of the ambient air quality.

Specific problems at the Cupola based foundries are:

i) High particulate matter concentration in the flue gases.
ii) High temperature of the flue gas.
iii) Release of heat and dust from the charging door.

4. AIR POLLUTION CONTROL SYSTEM

Based on the data collected for different sized cupola furnaces the air pollution control system as shown in figure 2 & 3 has been developed which comprises of the following units:

i) The Heat Exchanger

The heat exchanger unit is a Single Pass Water Cooled, MS Shell and Tube type with protective coating on inlet tube plate, capable of reducing the flue gas temperature from 600° C to 200° C. The pressure drop across the heat exchanger is calculated to be 12mm (flange to flange).

ii) The Cyclone Separator

The cyclone separator is a structure without moving parts in which the velocity of the inlet gas stream is transformed into a confined vortex from which centrifugal forces tend to drive the suspended particles to the wall of the cyclone body for their ultimate removal through the bottom.

iii) The Cooling Tower

The purpose of providing the cooling tower is to reduce the temperature of the water circulating in the heat exchanger.

iv) I.D. Fan

The purpose of providing an I.D. Fan is to create the negative pressure in the system including the cupola furnace and force the flue gases through the stack into the atmosphere.

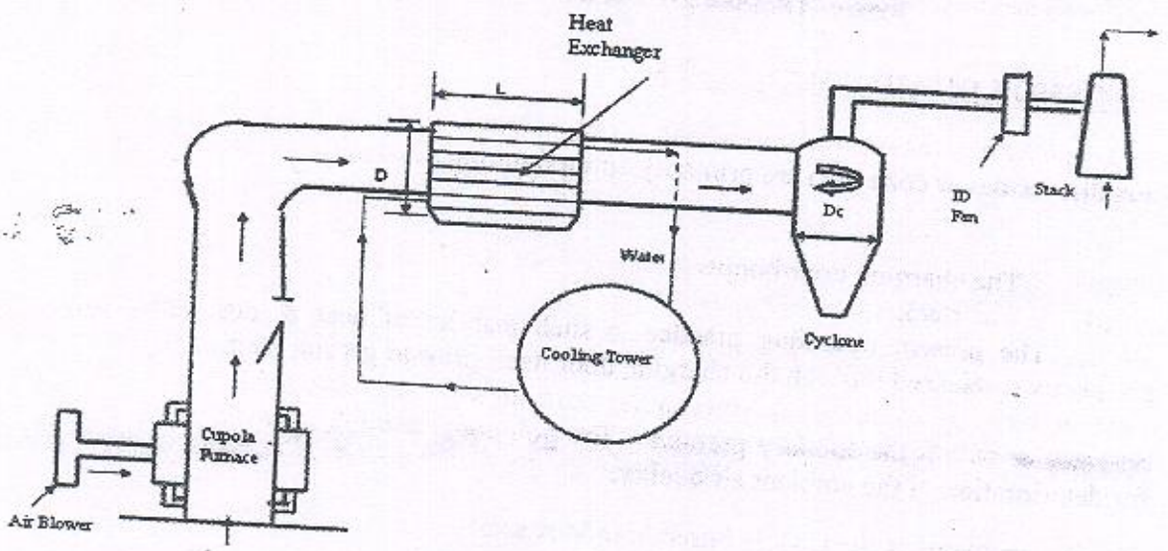


Figure:- 2 Arrangement of Air Pollution Control System for 45,53 & 60cm ID Cupola furnace

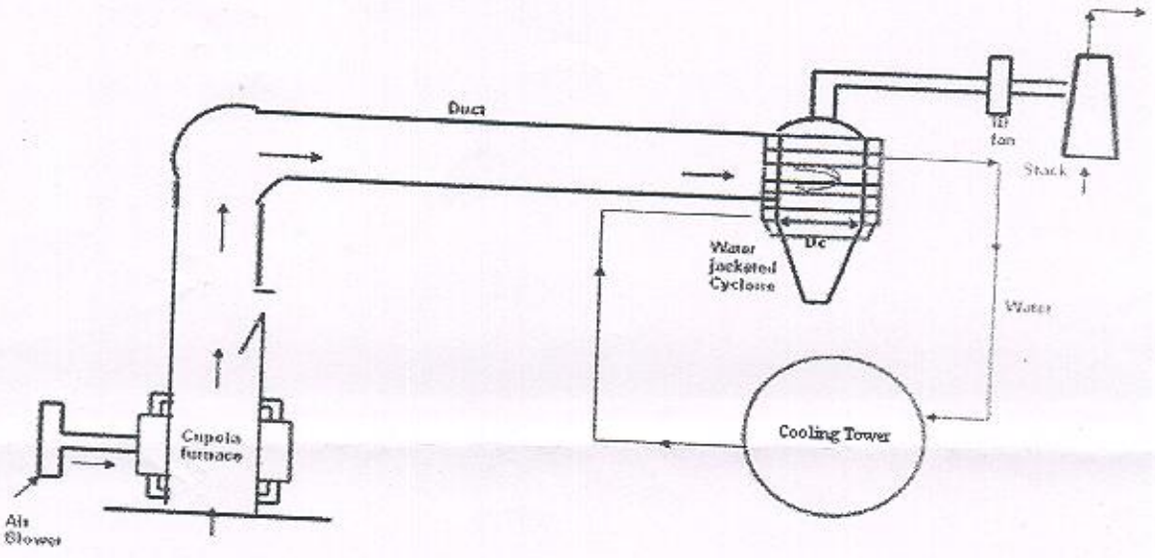


Figure:- 3 Arrangement of Air Pollution Control System for 30-38 cm ID Cupola furnace

Figure 2 & 3 depicts the water cooled system for Cupola Furnace sizes 45, 53 & 60 cm ID and 30-38 cm ID respectively.

6. RESULTS :

The effect of adopting the IAPC system is reflected in the results presented in the Table 1

Sr No.	Without APC system				With APC system			
	Temp. °C	PM mg/Nm^3	SO_2 ppm	NO_2 ppm	Temp. °C	PM mg/ Nm^3	SO_2 ppm	NO_2 ppm
1.	305-630	642-1542	9- 30	15- 31	115-200	120-140	2.4- 12	0.1-1.7

% Reduction in the pollution parameters			
Temp. °C	PM mg/Nm^3	SO_2 ppm	NO_2 ppm
62-68	81-90	60-73	94-99

7. ACCEPTABILITY

The developed IAPC system has found wide acceptability among the Cupola based foundries of Ahmedabad and has been acclaimed by the GPCB as one of the most effective air pollution control systems.