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Design and Development of Thermal Power Plant Exhaust Gas Cleaning Machine

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***Abstract*— An Exhaust gas Cleaning Device is designed to effectively use the energy from the inlet gas stream to atomize the liquid being used to scrub the gas stream. This type of technology is a part of the group of air pollution controls. The air pollution generated from the industry is now become serious problem for the environment, which affect the living and non-living thing on the Earth. Among all the air pollution monitoring equipment this has found to suitable for prevention of air pollution by pesticide. An Efficient gas Cleaning system making use of heterogeneous nucleation and condensational growth of particles was designed and tested to remove small particles from the exhaust of a exhaust where residual gas was abated and lots of fine particles were generated. In front of this device, normal-temperature fine-water mist mixes with high-temperature exhaust gas to cool it to the saturation temperature, allowing submicron particles to grow into micron sizes.**

Keywords*— Materials- Venturi Tube, Water Sprayers, Filter, Fan(Induced Draft, Forced Draft)

I. INTRODUCTION

The major problem of this type of industry is that the exhaust gas coming from the outlet is highly polluted and it affects the living lives so it is the major concern to overcome this, to overcome this problem we are going to clean the exhaust gas coming from the Power Plant and make it less polluted which is highly effective.

II. MATERIALS FOR THE PROPOSED DESIGN

A. *Venturi Tube*

The simplest apparatus that has Fluid flows through a length of pipe of varying diameter. To avoid undue drag, a Venturi tube typically has an entry cone of 30 degrees and an exit cone of 5 degrees.

Venturi tubes are available in various sizes from 100 mm to 813 mm with flow coefficient value of 0.984 for all diameter ratios. They are widely used due to low permanent pressure loss. They are more accurate over wide flow ranges than orifice plates or flow nozzles. However it is not used where the Reynolds number is less than 150,000.

B. *Water Sprayers*

A spray nozzle is a precision device that facilitates dispersion of liquid into a spray. Nozzles are used for three purposes: to distribute a liquid over an area, to increase liquid surface area, and create impact force on a solid surface. A wide variety of spray nozzle applications use a number of spray characteristics to describe the spray.

C. *Filter*

Water treatment process that remove contaminants from water by using pressure to force Water molecules through a semi permeable membrane. During this process the contaminants are filtered out and flushed away, leaving clean, reduce air pollution.

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D. Fan

Fan is used to push the air to cyclonic separator. While pushing the air it separate the dust from the air.

I. Equations

PRESSURE DROP IN VENTURI TUBE

$$\Delta P = 0.532 \times vt^2 \times pg \times At^{0.133} \times [0.56 + 16.6 \times QI/Qg + 40.7 \times QI^2/Qg]$$

Where,

ΔP = Pressure drop, Pa

Vt = throat velocity, m/s

Pg = gas density down-stream of throat, kg/m3

At = throat area, m2

Qi = volumetric flow rate of liquid, m3/s

Qg = volumetric flow rate of gas, m3/s

1) Operating Characteristics of Venturi Scrubber

Pollutant	Pressure drop (Δp)	Liquid-to-gas ratio (L/G)	Liquid-inlet pressure (pL)	Removal efficiency
Gases	13-250 cm of water (5- 100 in of water)	2.7-5.3 l/m^3 (20-40 gal/1,000 ft^3)	< 7-100 kPa (< 1-15 psig)	30-60% per venturi, depending on pollutant solubility
Particles	50-250 cm of water (50- 150 cm of water is common) 20-100 in of water (20-60 in. of water is common)	0.67-1.34 l/m^3(5-10 gal/1,000 ft^3)		90-99% is typical

1.1 Why Thermal Power Plant Exhaust Gas Cleaning Machine ?

Air pollution is the introduction of particulates, biological molecules, or other harmful materials into Earth's atmosphere, causing disease, death to humans, damage to other living organisms such as food crops, or the natural or built environment. Air pollution may come from anthropogenic or natural sources.

The atmosphere is a complex natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has been recognized as a threat to human health as as to the Earth's ecosystems.

Venturi scrubbers have been designed to collect particles at very high collection efficiencies, sometimes exceeding 80%. The ability of venturi is to handle large inlet volumes at high temperatures makes them very attractive to many industries; consequently, they are used to reduce particulate emissions in a number of industrial applications.

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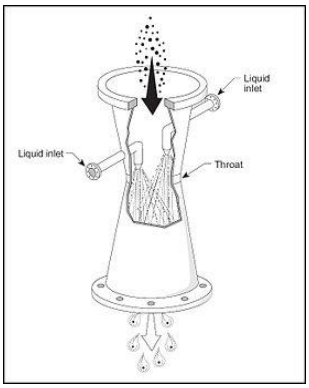
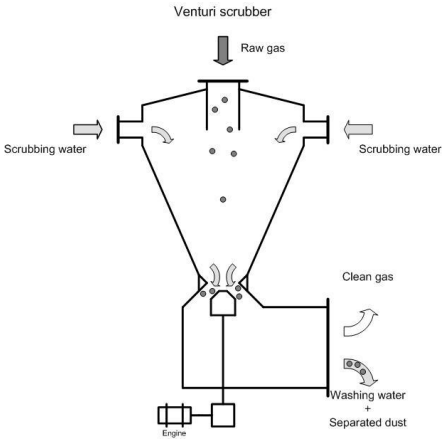
a. Working Principle of Venturi Tube

A Venturi Tube is a wet scrubber that essentially washes gases or particulates out of a gas stream. To accomplish this removal it is necessary to mix the "dirty" gas with fine droplets of the fluid used to remove them. A Venturi accomplishes this by passing the washing fluid through a tapered neck in the Venturi nozzle introducing the gas and liquid into the system. The high speed gas breaks the fluid into tiny droplets and mixes them with itself. The fluid picks up the impurities and coalesces into larger droplets which either fall out of the gas or are collected on impingement plates or packing. The purified gas leaves the system, the dirty fluid is sent for disposal or purified for reuse.



b. Working Principle of Thermal Power Plant Exhaust Gas Cleaning Machine

A (TPEGCM) consists of a converging section, a throat (the narrowest part of the venture tube) and a diffuser. The dust/gas mix flows through the venturi tube and reaches top speed in the throat section. Thereafter, the mixture passes into the diffuser where the speed drops again. Liquid is added to the gas flow either in the throat section or prior to it. Intensive mixing takes place between the gas and the liquid in the throat section of the venture tube. Due to the high speed realized by the gas and liquid, water is released in fine water droplets.



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