

Use of Scrubber in Petrol and Diesel Engines

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Abstract- ‘Scrubber’ systems are a diverse assembly of air pollution control devices that can be used to confiscate some particulate and/or gases from petrol and diesel exhaust streams. The exhaust gases of combustion contain substances considered hazardous. Wet scrubbers that remove gaseous pollutants are referred to as absorbers. The scrubber may remove or neutralize those substances. The main objective of this experiment was to develop a method that would assist in reduction of particulate matters emitted from petrol and diesel engines exhaust. The technique involved post combustion capture method in which exhaust gas was passed through water in a configuration. The first experiment was conducted on a 97 cc bike engine. The turbidity of water changed with a gain of sunset yellow color and a very slight gain in mass was observed along with an eye etching odor. The second experiment was conducted on a stationary generator and the exhaust was passed through a configuration. This technique trapped almost 90% particulate matters and the exhaust gas after passing through the configuration was almost 90% carbon free. This technique can be used in both petrol and diesel engines for controlling particulate matter emissions from exhausts. Good gas-to-liquid contact is essential to obtain high removal efficiencies in absorber. This technique will also be helpful in reducing carbon haze.

Keywords – Wet scrubber, particulate matters, exhaust gas, water, carbon haze, petrol and diesel engines.

I. INTRODUCTION

Scrubber systems are a diverse group of air pollution control devices that can be used to remove particles and/or gases from industrial exhaust streams. Traditionally, scrubbers have referred to pollution control devices that used liquid to "scrub" unwanted pollutants from a gas stream. Recently, the term *scrubber* is also used to describe systems that inject a dry reagent or slurry into a dirty exhaust stream to "scrub out" acid gases. Scrubbers are one of the primary devices that control gaseous emissions, especially acid gases^[2].

Wet scrubber is a term used to describe a variety of devices that use liquid to remove pollutants. In a wet scrubber, the dirty gas stream is brought into contact with the scrubbing liquid by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method. Of course the design of any air pollution control device (wet scrubbers are no exception) depends on the industrial process conditions and the nature of the air pollutants involved. Exhaust gas characteristics and dust properties, if particles are present, are of primary importance. Scrubbers can be designed to collect particulates and/or gaseous pollutants. Wet scrubbers remove particles by *capturing* them in liquid droplets. Wet scrubbers remove pollutant gases by *dissolving* or *absorbing* them into the liquid. Any droplets that are in the flue gas must then be separated from the clean exhaust stream by means of another device referred to as a mist eliminator or entrainment separator (these terms are interchangeable). Also, the resultant scrubbing liquid must be treated prior to any ultimate discharge or reused in the plant^[2].

Wet scrubbers that remove gaseous pollutants are referred to as absorbers. Good gas-to liquid contact is essential to obtain high removal efficiencies in absorbers. A number of wet scrubber designs are used to remove gaseous

pollutants, with the packed tower and the plate tower being the most common. If the exhaust stream contains both particles and gases, wet scrubbers are generally the only single air pollution control device that can remove both types of pollutants. Wet scrubbers can achieve high removal efficiencies for either particles or gases and, in some instances, can achieve high removal efficiency for both pollutants in the same system. However, in many cases, the best operating conditions for particle collection are the poorest for gas removal. In general, obtaining high simultaneous gas and particle removal efficiencies requires that one of them be easily collected (i.e., that the gases are very soluble in the liquid or that the particles are large and readily captured)^[3].

For particulate control, wet scrubbers (also referred to as wet collectors) are evaluated against fabric filters and electrostatic precipitators (ESPs). Some advantages of wet scrubbers over these devices are as follows:

- Wet scrubbers have the ability to handle high temperatures and moisture.
- In wet scrubbers, flue gases are cooled, resulting in smaller overall size of equipment.
- Wet scrubbers can remove both gases and particles.
- Wet scrubbers can neutralize corrosive gases.

Some disadvantages of wet scrubbers include corrosion, the need for mist removal to obtain high efficiencies, the need for treatment or reuse of spent liquid, and reduced plume buoyancy. Wet scrubbers have been used in a variety of industries such as acid plants, fertilizer plants, steel mills, asphalt plants, and large power plants^{[1][3]}.

II. METHODS AND MATERIALS

The main objective of this experiment was to develop a method that would assist in reduction of particulate matters emitted from petrol and diesel engines exhaust. The technique involved post combustion capture method in which exhaust gas was passed through water in a configuration. The first experiment was conducted on a 97 cc bike engine and the exhaust was passed through scrubber containing approximately 1 liter plain water for approximately 60 minutes. Firstly, the exhaust pipe i.e. the silencer of the bike was extended by welding a pipe with thick cross-sectional area so that it can submerge and fit easily inside a jar. The exhaust pipe is bent in such a way that it submerges easily inside the jar. The level of water is kept well above the mouth of exhaust end from where exhaust gases escape. As the engine is started, the exhaust gases passes through water in the jar. This experiment was conducted for approx 1 hour while the engine was running at idling speed. As a result of which the particulate matters got trapped in water with traces of oil. This experiment not only reduced particulate matters from escaping into air and causing air pollution but it also acted as silencer as the engine sound got stepped down to some extent. This experiment did not affect the performance of the engine and was totally safe. The turbidity of water changed with a gain of sunset yellow color and a very slight gain in mass was observed along with an eye etching odor. The second experiment was conducted on a stationary generator and the exhaust was passed through a configuration containing approximately 10 liters plain water for 15 minutes. This technique trapped almost 90% particulate matters and the exhaust gas after passing through the configuration was almost 90% carbon free. This technique can be used in both petrol and diesel engines for controlling particulate matter emissions from exhausts. Good gas-to-liquid contact is essential to obtain high removal efficiencies in absorber.

2.1 Required Materials

- Self-Instructional Manual, Scrubber Systems Operation Review
- Final examination
- Timer

2.2 Supplemental Materials

- silencer, generator, Scrubbers(water): Operating Principles and Components^[4]

III. RESULT AND DISCUSSION

The turbidity of water changed with a gain of sunset yellow color and a very slight gain in mass was observed along with an eye etching odor. This technique trapped almost 90% particulate matters and the exhaust gas after passing through the configuration was almost 90% carbon free. Wet scrubbing systems are devices that use a liquid

(generally water) to remove particulate and/or gaseous pollutants from a process exhaust gas stream. There are numerous different configurations of wet scrubbers. All designs attempt to provide good liquid-to-pollutant contact in order to obtain high removal (95% plus) efficiencies. Wet scrubbers saturate the gas stream thereby creating a steam plume and resulting wastewater stream that must be treated or reused in the plant. Also, since the gas stream is saturated with liquid, a mist eliminator or entrainment separator is often an integral part of any wet scrubbing system. Mist eliminators (entrainment separators) remove and/or recycle the scrubbing liquid in addition to providing additional pollutant removal^[3]. To evaluate scrubber designs, this manual provides both a generalized review of design equations/procedures and operating information on specific scrubbing systems. Reviewers can use this information to determine if the scrubbing system is operating within normal ranges compared to other similar systems. This will provide the reviewer with a starting point to develop a list of questions aimed at vendors or operators that will aid in evaluating the adequacy of the design^[4].

OMEGA TEST HOUSE	
Head Office : 2/60, Malviya Nagar, Jaipur-302 017 Lab: J-889, Sitapura Industrial Area, Jaipur Phone: 0141-2521969, Mobile 99829051363, 09414074020	
TEST REPORT	
Name of Party: Gourav Khandelwal, Jaipur.	Letter Date : N.S
Name of Sample: Exhaust Water	Date of Receipt : 08.10.2012
Sample Code : 1210011	Date of Testing : 08.10.2012
Report No : 2338	REG No. R.A.J. 1713/042971
SOP No. of Sampling: QCO021	
<u>Chemical Analysis</u>	
Total Suspended Solids :	95 mg/ltr.
END OF REPORT	
Date 11.10.12	 Person in charge of testing
<small>NOTE: (1) The report listed refer only to the tested sample and applicable parameters. Endorsement of products is neither inferred nor implied. (2) Total liability of our concern is limited to the invoiced amount. (3) This report is not to be reproduced wholly or in part and cannot be used as an evidence in the court of law and should not be used in any advertising media without our special permission in writing.</small>	

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V. CONCLUSION

The use of water scrubber system in petrol and diesel engines may be helpful in reducing the pollutants emitted from the engines especially the particulate matters which produce smog and problem of carbon haze over earth atmosphere.

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