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ANALYSIS DUST GAS CLEANING TECHNOLOGICAL PROCESSES

Abduraxmonov O.R.
Doctor of technical sciences, professor, Bukhara engineering technological institute
Raxmatov Sh.B.
Master`s student, Bukhara engineering technological institute

Abstract: The exhaust gas cleaning process is a multistep system where the first step is usually fly ash separation. Common technologies used for dust separation from exhaust gas include cyclones, electrostatic precipitators, and filters. Gas cleaning devices vary in their removal efficiencies, but almost invariably they are more efficient at removing particulate, rather than aerosol size range material. Even so, the least efficient device for removing small particle sizes, the gravity settling chamber, still plays an important role in emission control. When the gas stream to be cleaned has only large particles present which can be effectively removed by the device, then this device alone represents an inexpensive method of control. When the particle size range to be collected is wider than this, and a dry cyclone is to be used for final particle collection, very large particles. Common technologies used for dust separation from exhaust gas include cyclones, electrostatic precipitators, and filters.

Key words: Dusty gas, gas cleaning process, dust collector, gasfeed, clean gas outlet, filtration units.

Introduction: To clean dusty gases, they are washed with water or other liquids and cleaned of solid particles. This method is used in cases where cooling and humidification of gases is allowed, and solid particles are not expensive. It is known that when gases are cooled, water vapor condenses, particles become wet and their density increases. As a result, solid particles are easily separated from the gas. In this case, the particles act as condensation centers. If the particles are not wetted by the liquid, then the cleaning of gases in this type of devices is ineffective. In such cases, to increase the level of gas purification, alcohol - surfactants are added to the liquid, that is, the wetting ability of the liquid is increased. Depending on their design, gas cleaning rates in liquid scrubbers range from 60 to 85%. The main disadvantage of this type of devices is that wastewater is generated as a result of the cleaning process. It is known that waste water should be cleaned in turn. Scrubbers are hollow or tubular, and depending on the cross-sectional surface, cylindrical or rectangular columns.One of the main characteristics of wet dust cleaning devices is the increase of contact surfaces and thus the selection of optimal parameters of hydraulic resistance, cleaning efficiency and energy consumption. Therefore, most of the research work in this area is focused on the creation of a simple design of surface contact elements of the device and a type of high-quality work. It is known from the results of research to date that the hydraulic resistance in the surface contact element decreases as it is simplified, but this factor has a negative impact on the cleaning efficiency of the device. In addition, the leakage of liquid droplets increases along with the purified gas from the device. This in turn increases the accumulation of dust particles in the pipes of the device.

Dusty gas is introduced into hollow scrubbers from the bottom of the device at a speed of 0.8...1.0 m/s. The gas changes its direction and moves upwards. Water or other liquid is sprayed from the sprayer at the top of the scrubber, and the small droplets are directed downwards under the influence of gravity. As a result, gas and water droplets hit each other many times in opposite directions. Due to this interaction, the solid particles contained in the gas are washed with the liquid, become heavy and fall down, forming wastewater. The cleaned gas exits the scrubber at the top of the scrubber. Waste water is discharged through the pump at the bottom of the device for cleaning [1]. A gas cleaning system for removing at least a portion of contaminants, such as halides, particulates, mercury, and others, from a synthesis gas (syngas). The gas cleaning system may include one or more filter vessels coupled in series for removing halides, particulates, and from the syngas. Raw natural gas is commonly collected from a group of adjacent wells and is first processed in a separator vessel at that collection point for removal of

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free liquid water and natural gas condensate. The condensate is usually then transported to an oil refinery and the water is treated and disposed of as wastewater. Mechanical cleaning systems are used to remove contaminants of work surface by propelling abrasive materials through any of these three principal methods: airless centrifugal blast blade- or vane-type wheels; compressed air, direct-pressure dry blast nozzle systems; or compressed-air, indirect-suction (induction) wet [2]. Gas exchange occurs at two sites in the body: in the lungs, where oxygen is picked up and carbon dioxide is released at the respiratory membrane, and at the tissues, where oxygen is released and carbon dioxide is picked up.

In order to increase the intensity and speed of the cleaning process, nozzles are definitely placed on the scrubbers. As a result of the use of nozzles, the friction between the gas and liquid phases increases, that is, the collision surface increases. Scrubbers are usually equipped with annular or chord nozzles. In some cases, a layer made of coke or quartz pieces can be used as a nozzle. In nozzle scrubbers, the degree of gas purification is 75...85%. The gas that needs to be cleaned is transferred from the bottom of the device to the nozzle. It is known that the conicity increases in the diffuser part of the Venturi tube. This leads to a decrease in pressure in the diffuser, that is, a vacuum is created [3]. Due to this vacuum, water is drawn from the tank through the collector to the Venturi tube. The liquid phase separates into small droplets (~10 µm) as a result of contact with the gas. During the collision of gas and small droplets, liquid droplets attract solid particles and grow larger. Then, these droplets pass through the diffuser along with the gas flow, and as a result, their speed decreases. The agglomeration device serves to separate the gas flow from the liquid particles. Dust collection systems are often part of a larger air quality management program that also includes large airborne particle filtration units mounted to the ceiling of shop spaces and mask systems to be worn by workers. Air filtration units are designed to process large volumes of air to remove fine particles (2 to 10 micrometres) suspended in the air. Masks are available in a variety of forms, from simple cotton face masks to elaborate respirators with tanked air the need for which is determined by the environment in which the worker is operating [4]. Larger systems utilize a two-stage system, which separates larger particles from fine dust using a pre-collection device, such as a cyclone or baffled canister, before drawing the air through the impeller. Air from these units can then be exhausted outdoors or filtered and recirculated back into the work space.

The liquid separated in the separator flows into the collector. The purified gas is released into the atmosphere through the nozzle at the top of the scrubber.

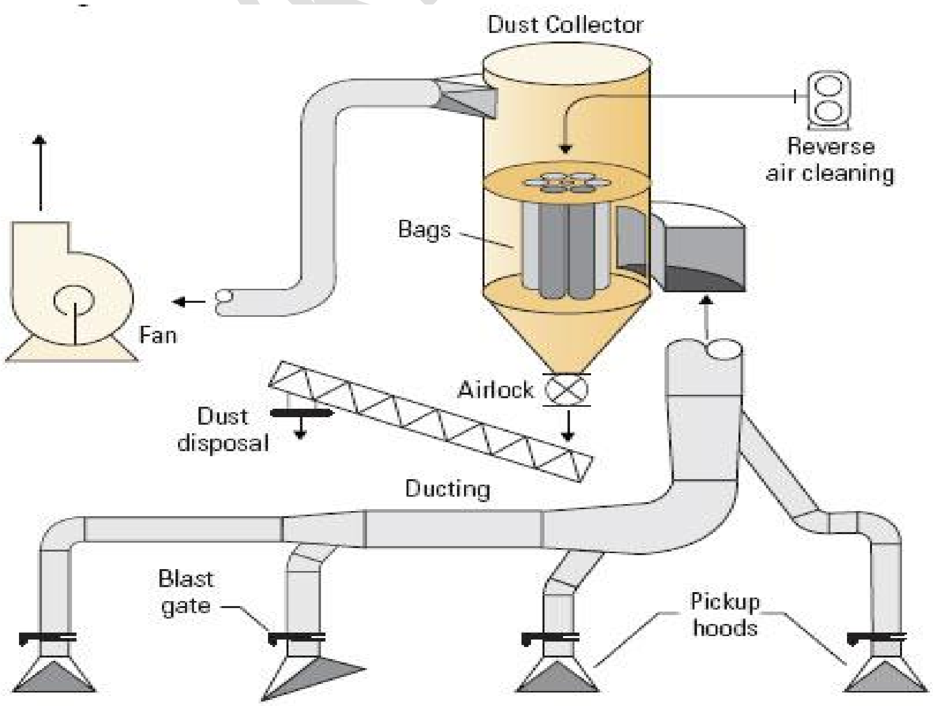

Figure 1. Dust collection system

A dust collection system is an air quality improvement system used in industrial, commercial, and home production shops to improve breathable air quality and safety by removing particulate matter from the air and environment. Dust collection systems work on the basic formula of capture, convey and collect.

Hydrocarbons extracted from gases are valuable raw materials for the production of various chemical products. That is why gas processing is an urgent issue. One of the main goals is to analyse the operational status and utilization capacity of gas recycling and gas condensate raw materials recycling [6]. The following should be taken into account when making perspective forecasts for supplying petrochemical and chemical industry enterprises with hydrocarbon raw materials.

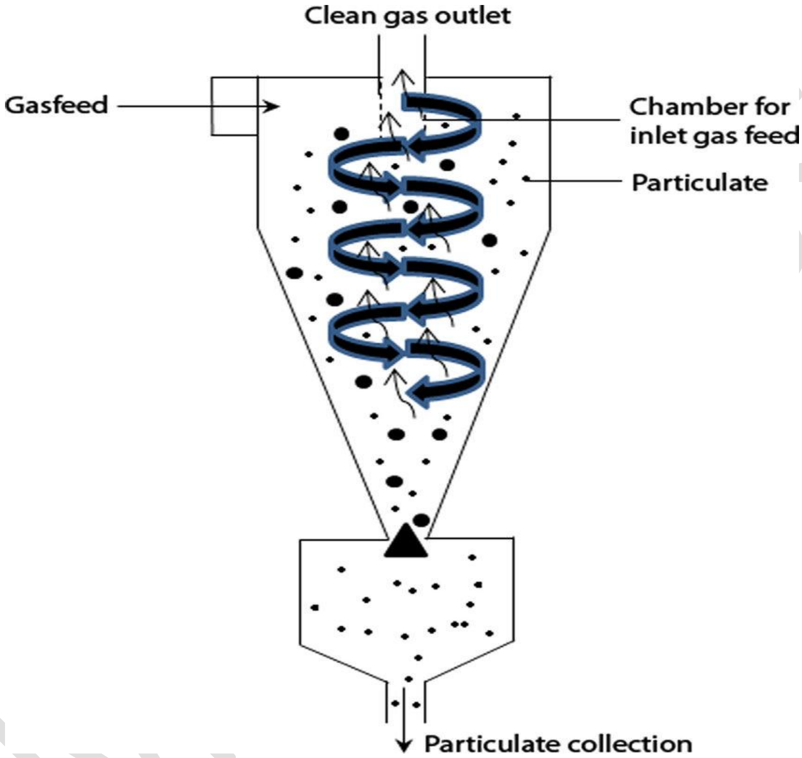

Figure 2. Schematic of typical cyclone system used in cleaning of flue gases

Dusty gas is introduced in the tangential direction at a speed of 10...40 m/s through the inlet pipe of the cyclone. Since there is a tangential inlet and a central exhaust pipe inside the device, the gas flow spirals down. This, in turn, leads to the generation of centrifugal force. Under the influence of this force, solid particles in the gas flow are thrown against the inner wall of the cyclone, lose their kinetic energy by hitting the wall, and fall towards the bottom of the device under the influence of gravity. In the lower conical part of the cyclone, the gas flow continues spiralling under the influence of the force of inertia, and as the diameter of the cone decreases, an upward flow appears [5]. This stream is a purified gas that exits the cyclone through the central pipe. Since the accurate calculation of cyclones is very complicated, simplified calculations are made on the parameter of hydraulic resistance. The false velocity of the gas in the cylindrical part of the cyclone wf (m/s) can be determined using the following formula: It is based on the construction of cyclones that work in secret. The separator with a return barrier is designed for the separation of large dispersed dusts. The return barriers serve to accumulate the gas flow. Inertia forces generated during passage through obstacles cause intensive sedimentation of solid particles. Large particles collected in the collector 2 are removed using the sieve 3. Such devices are installed in gas transmission systems. The structure of dust cleaning devices operating on the basis of inertial forces is simple and compact.

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In conclusion, most of the dust particles in the gas are negatively charged, because the negative electron is more mobile than the positive ions, and the ions travel a greater distance before reaching the deposition electrode. Therefore, there is a high probability of their collision with particles in the gas. A small fraction of dust or fog particles settles on the "crown" electrode only when they collide with the positively charged ions around the "crown" electrode. When negatively charged ions, dust or fog particles reach the deposition electrode, they give it their charge and settle under the influence of gravity. Such a deposition process is carried out in an electro filter. In order to reduce the harmful effects of dust particles that have settled on the electrodes, the particles that have settled on the electrodes are periodically shaken off or the dusty gas is moistened before entering the electro filter (to increase its permeability).

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