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METHODS OF IMPROVING THE RELIABILITY OF COMPONENTS IN THE MANAGEMENT OF THE ACETYLENE PRODUCTION PROCESS

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Abstract. Acetylene appears as a colorless gas with a faint garlic-like odor. Easily ignited and burns with a sooty flame. Gas is lighter than air. Flame may flash back to the source of a leak very easily. Acetylene is made of two hydrogen and two carbon atoms and is chemically represented as C2H2. This hydrocarbon is produced by one of two processes-chemical reaction or thermal cracking, using different types of raw materials. In various industrial environments, acetylene generation is initiated in acetylene producing generators. This equipment is sold in various capacities from 8 m3 to over 200 m3 per hour. Calcium carbide is introduced from the top of the generator shell into the water. The chemical formula of this reaction can be expressed as: CAC2 + 2 H2O → C2H2 + CA(OH)2. This reaction should only be conducted under controlled conditions. The process unit should be equipped with pressure and temperature sensors, as well as non-return valves for safety purposes.

Key words: Acetylene, carbon atoms, an organic compound, acetylene condenser

high pressure dryers.

Introduction. Acetylene is an organic compound that belongs to the category called "Hydrocarbons" and has the chemical formula C_2H_2. It is gaseous in nature, is colourless, odorless, and is the simplest "Alkene". It is widely used as a fuel as also used as the starting material for the preparation of a number of other compounds. It is highly unstable in the natural form as is thus handled in the form of solution. Since the gas is odorless, the commercial grade has odor due to the presence of impurities such as phosphine and divinyl sulfide. Acetylene is the most efficient of all fuel gases and provides high levels of productivity due to the fact that it requires the least amount of oxygen to ensure complete combustion [1]. A low flame moisture content makes this a good choice for many critical industrial heating processes such as flame heating, flame gouging, welding, flame hardening, flame cleaning, flame straightening, thermal spraying, spot heating, brazing, texturing, profile-cutting, branding wooden pallets, wood aging, and carbon coating. It is the only fuel gas that is recommended for underground working conditions as it is lighter than air [2]. It is also the only fuel gas, for instance, that can weld steel. In cutting, Oxy-acetylene flame gives the fastest pre-heating piercing times than any other fuel gas combination. Some of the major benefits of using the Oxy-Acetylene flame are:

- Improved Cut Quality
- Higher cutting speeds
- Fastest cut initiation time
- Reduced oxygen use.

The manufacturing process for Acetylene gas by the Calcium Carbide Process is as given below:

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The process begins with the procuring of Calcium Carbide for the process. Calcium carbide vigorously reacts with water to form the Acetylene gas. So, the removal of the excess amount of heat from the reaction chamber is very important. There are several variations of this process in which either calcium carbide is added to water or the water is added to the calcium carbide. There is a third process in which a limited amount of water is added and is called the Dry Process which is mentioned here.

A high capacity Acetylene Generator is used for this purpose. The generator uses a rotating screw to feed calcium carbide granules into the reaction chamber which has been filled up to a certain level with water [3]. The granules measure about 2mm x 8mm, providing the right amounts of exposure to allow for a complete reaction. he feed rate is determined by the desired rate of gas flow and is controlled by a pressure switch in the chamber. If too much gas is being produced at one time, the pressure switch opens and cuts back the feed rate.

To ensure that complete reaction takes place, the reaction chamber is agitated by a set of rotating paddles inside the reaction chamber. These paddles also prevent any granule from floating on the top of the water surface that may overheat and cause explosion. The acetylene gas, bubbles to the top of the surface and is removed and is drawn off under low pressure [4]. As it leaves the reaction chamber, the gas is cooled by a spray of water. This water spray also adds water to the reaction chamber to keep the reaction going as new calcium carbide is added. After the gas is cooled, it passes through a flash arrester, which prevents any accidental ignition from equipment downstream of the chamber. As the calcium carbide reacts with the water, it forms a slurry of calcium carbonate, which sinks to the bottom of the chamber. Periodically the reaction must be stopped to remove the built-up slurry. The slurry is drained from the chamber and pumped into a holding pond, where the calcium carbonate settles out and the water is drawn off. There is an ammonia scrubber that uses water in removing any ammonia that might be present in the acetylene system. This is done to make the Acetylene purification system last longer [5]. The acetylene gas is dried by passing it through a calcium carbide chamber at medium pressure. The dried acetylene gas is then passed through acetylene purifier which removes any kind of impurities such as phosphine, arsine, and hydrogen supplied. This step can be bypassed for industrial grade acetylene. Finally, the purified acetylene gas passes through purification scrubbers to remove any traces of the purification material.

Carbide Hopper Filling Cart: It is cart that is “Custom-built” with spark resistant features and the capacity to match the generator’s hopper size. It is used to move the Carbide to the generator hoppers for filling. The sizes can be 200 – 1200 kg.



Figure 1. Carbide hopper filling cart

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Acetylene Generator: This is the main area for the production of the acetylene gas. The machine is configured with intrinsically safe pressure controls to maintain the system operating pressure [6]. The safety relief valves are capable of relieving up to relieving 638 Kg/hour and 807 kg/hour (25,800 scfh/hour), depending on the plant model. Two water filled flashback arresters with check valves are provided to protect the generator from flashes up stream.

Figure 2. Acetylene Generator

Acetylene Condenser: To cool the acetylene gas generator which is hot and laden with moisture. The condenser is used for cooling the gas and condenses the excessive moisture in preparation for its subsequent elimination. The capacity of the condenser is decided according to the local conditions and ensures total cooling, provided that sufficient water supply is maintained.



Figure 3. Acetylene Condenser

High pressure dryers: These consists of three columns. The first column is filled with packing to avoid any void and for proper mixing and the second and third are filled with anhydrous calcium chloride. It is solid and improves performance. It is very imperative that the high-pressure drier is fully filled up with Calcium Chloride, as any void in highpressure area is against the required safety. It must be ensured that acetylene high pressure drier is of high quality and meets the international quality standards.

Figure 4. High pressure dryers

The acetylene is compressed into a cylinder at a pressure of about 300 psi (2,070 kPa) that has liquid acetone and porous monolithic mass filler. This acetone in the filler allows there to be 25 times more acetylene in the cylinder than if there was no acetone. Once dissolved, it loses its explosive capability, making it safe to transport [7]. When the cylinder valve is opened, the pressure drops some of the acetylene to causes vaporize into gas again and flow through the connecting



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hose to the welding or cutting torch.

Conclusion. It is also used as a carbon source in molecular manufacturing, in calibration gases for the gas, oil and chemical industries and in lung testing gases. Acetylene is manufactured commercially by reacting calcium carbide and water. It is also a by-product of ethylene production. Secure it. Acetylene can be produced three different ways: It can be produced by the reaction of water and calcium carbide, by partial combustion of oxygen and methane, and by-passing hydrocarbon through an electric arc. Acetylene can easily be prepared from ethylene dichloride by the process of hydrohalogenation. It is a process in which a hydrogen atom is removed from 1 carbon atom and a halide atom is removed from the other carbon atom present at the anti-position to form a pi-bond between the two carbon atoms.

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