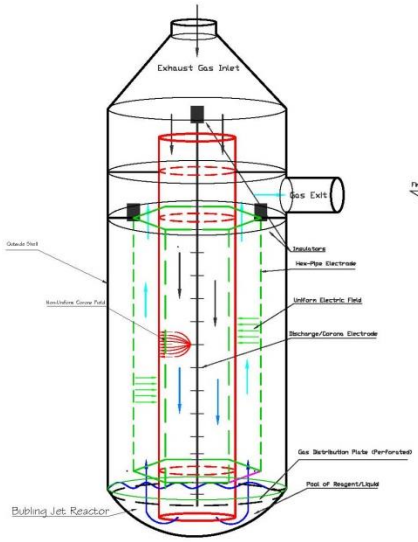
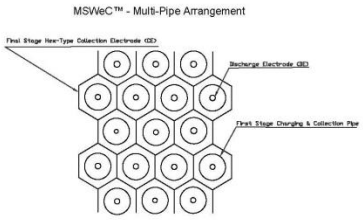
# MULTI STAGE WET COLLECTOR (MSWEC™) SYSTEM

The Multi Stage Wet Electrostatic Precipitator Collector System (MSWeC™) represents a major breakthrough in the advancement of state-of-the-art fine particulate control. Centered around precipitator hardware improvements that deliver high reliability and outstanding collection performance, the MSWeC™ System incorporates a unique multi-stage electrode/scrubbing technology that can be sized to specific applications. The system's electrode geometry combines a high intensity-ionizing corona in the first stage collecting tubes with subsequent scrubbing and intense uniform electric filed zones. This high intensity corona provides particle charging fields followed by scrubbing section with the final clean-up done by the intense uniform electric field– resulting in higher overall migration velocities, and smaller precipitator size.

## 1 INTRODUCTION

The Multi Stage Wet Collector (MSWeC™) is capable of extremely efficient controlling emissions to sub-micron level, including submicron particulates, condensed organics, gaseous acid compounds and heavy metals.




The MSWeC™ is a patented (Krigmont, 7,597,750) hybrid wet device for the removing chemical constituents, entrained sub-micron and nano-particulate material from a gas stream. The multi-stage collector is made up of concentric tubes or pipes with an internally formed gas path communicating between an inlet and an outlet. The Bubbling Jet Reactor (BJR) is located between the first and second electrical stages to provide chemical treatment of the gaseous mists in addition to particulate filtration as the gas passes through the control device.

# 2 DESIGN FEATURES

## 2.1 INLET – GAS COOLING SECTION

Gases are completely saturated before entering the electrostatic field by duct sprays, inlet sprays, ultrasonic fog systems, or other means. Here the flue gas is cooled and humidified.

## 2.2 FIRST STAGE – TUBULAR ELECTROSTATIC PRECIPITATOR

From the gas cooling section, the flue gas enters the first collector (*first* electrical stage, Figure 1), which, in essence, is a conventional tubular vertical flow electrostatic precipitator where the gas path incorporates a high-tension discharging zone to create a corona discharge to charge particles and to collect particulate. Each tube houses a solid electrode running the length of the tube, parallel to the grounded walls, and with coincidental longitudinal centerlines (Figure 3). The discharge electrode, positioned in the center of each tubular (collecting) electrode, is in the form of a rod with a number of sharp corona generating discharge points. Typically, the corona generating points are represented by a "saw" or a "star" discs, which are capable of attaining higher electric field strength.

**Figure 1. First (Red) Stage.**

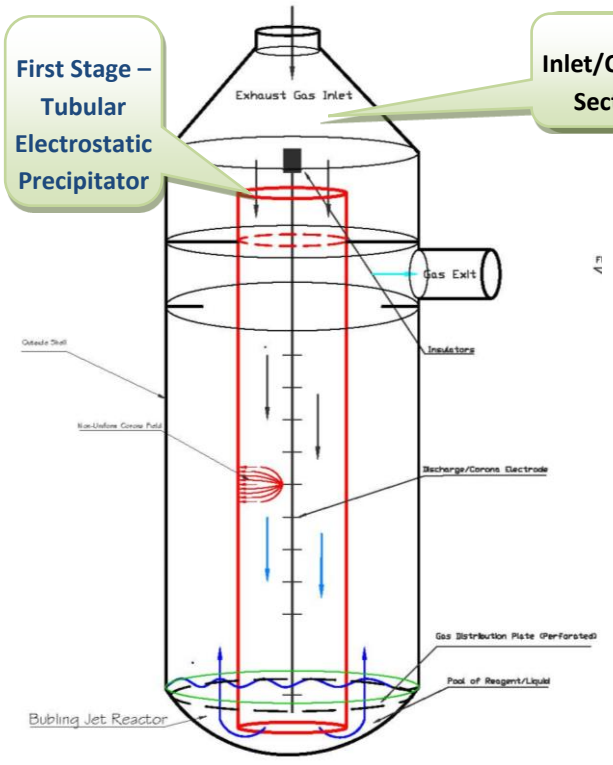
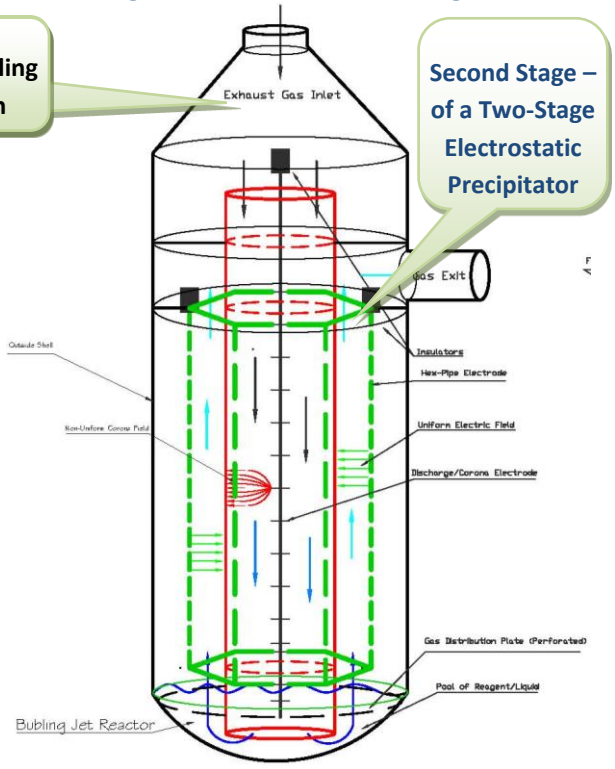
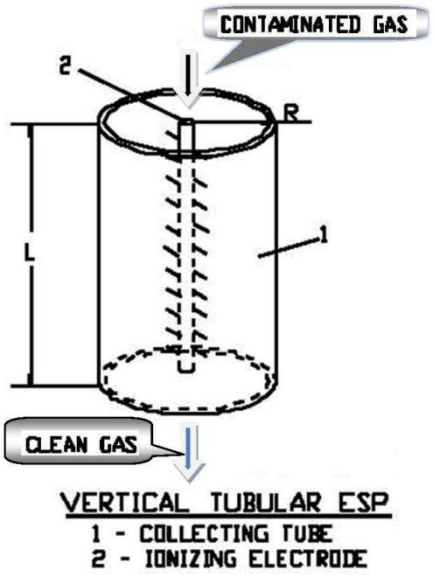



**Figure 2. Second (Green) Stage.**



Entrained particulate matter and liquid droplets that enter the first stage are charged by the high voltage produced by the discharge electrodes and collected on the grounded tubes (hence, the name: collecting electrodes). Subsequently, collected material flows down the tubes into the Bubbling Jet Reactor.

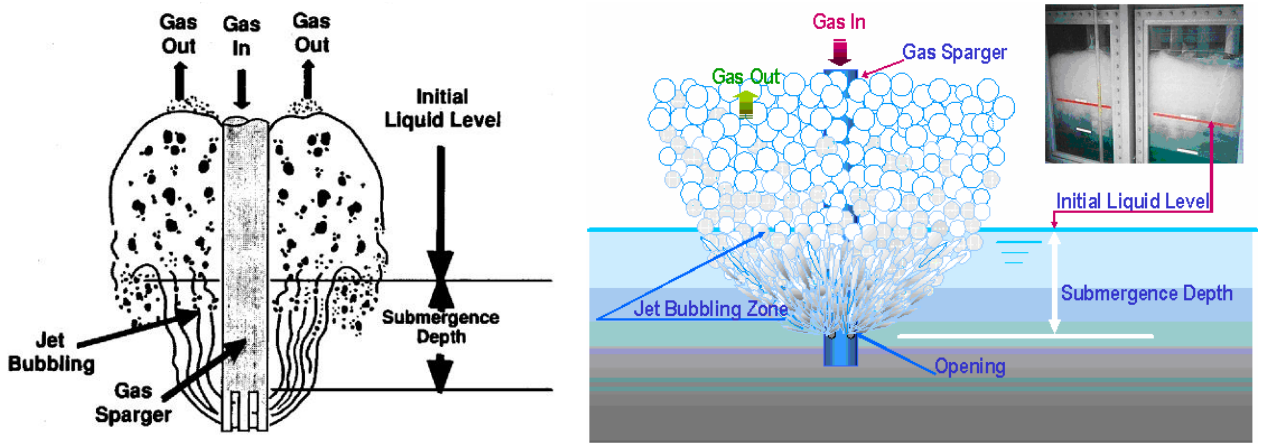
Figure 3. Typical Tubular Precipitator




## 2.3 BUBBLING JET REACTOR

One of the key features of the MSWeC™ design is the Bubbling Jet Reactor (BJR), in which most of the critical chemical reactions take place (*scrubbing* stage). The quenched flue gas is entered into the first electrical stage, from where it is forced into the absorbent liquid creating the crucial active area for mass transfer of pollutants from the gas phase to the liquid phase (Figure 4). The BJR is a high velocity impinging stream reactor, which is characterized by small reactor volumes supplied with nozzles, which are directed towards each other. Sparger tube openings force the inlet flue gas below the level of the slurry reservoir in the jet bubbling zone (froth zone) of the BJR as shown in Figure 4. The gas and liquid feed streams are jetted through the nozzles into the reactor volume, resulting in a highly turbulent mixture of the phases. Under these enhanced mixing conditions, mass transfer rates are increased dramatically.

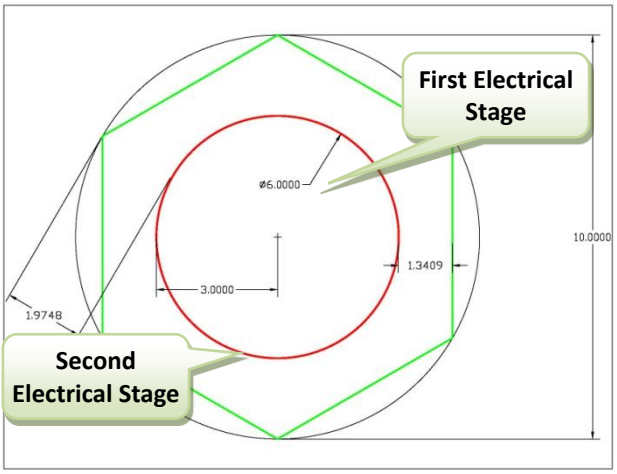
Figure 4. BJR Gas Sparger Action[6,7]




## 2.4 SECOND ELECTRICAL STAGE – TWO STAGE ELECTROSTATIC PRECIPITATOR

After bubbling through the slurry, where all the concurrent chemical reactions occur, the gas flows upward through a second collector, which is a two-stage electrostatic precipitator (*second* electrical stage, Figure 2). The two-stage precipitator is a series device with the discharge electrode, or ionizer, preceding the collector electrodes.

**Figure 5. Co-Centric Tubes Formation**




The second stage is formed by the cylindrical tubes of the first stage and concentric hex-tubes of a larger diameter creating a strong uniform high-tension electric field within (Figure 5). Entrained liquor in the cleaned gas disengages in a second stage due to a significant velocity reduction and a very strong high-tension uniform electrical field. Subsequently, collected material flows down into the Bubbling Jet Reactor. Intermittently, a dedicated flash system is used to clean the collecting surfaces.

### 2.5 HIGH TENSION POWER

A high-tension voltage source supplies a high voltage capable of generating a non-uniform corona discharge in the first zone and the uniform high-tension electric field in the second zone. The corona discharge in the first zone causes the fine particulate to become charged and to be captured on the collecting electrodes/pipes in the first and the second zones.

### 2.6 AUXILIARY SYSTEMS

Additional liquid flow/sprays are used to wash the collecting surfaces (tubes) in both electrical stages.

A recirculation pump system for the BJR liquor/slurry replenishment and cooling with incorporated pH and level controls shall be also provided.

## 3 BENEFITS

The benefits of the MSWeC™ technology include:

- Low capital and O&M costs;
- Lower electrical power consumption;

- Compact design;
- Reduced space requirement;
- Excellent particulate removal performance especially in the submicron and nano-particle;
- Excellent sulphuric acid and heavy metals removal; and
- High gas throughput in a compact design.

Specifically, the MSWeC™ technology is ideally suited for the moderate gas flow industrial applications requiring extremely efficient (PM2.5 and nano-particles) control with multi-pollutant hazardous exhaust gases.