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Why Mahip Salt Spray Chambers?

1. **Chamber Size- why 400 litres minimum**:

   ☞ *HUMARE COMPONENTS TOH CHHOTE HAIN, ITNI BADI MACHINE HUM KYA KARENGE, MACHINE CHHOTI CHAHIYE HAMEH.*

   This is the most common price related issue that crops up. Most international salt spray standards have laid down the minimum internal size of chamber as 400 Lts. (ISO 9227, DIN 50021), or 15 cu.ft. (= 425 Lts. In ASTM B117). This minimum size has been specified to ensure constancy of the process, especially the precipitation rate at different regions inside the chamber. For chambers of lower volume/ capacity, the precipitation rate has been found to be almost impossible to control consistently. This means that in smaller chambers, the corrosion testing results will vary with the position of the sample inside the chamber. The samples that are subject to higher precipitation rates (usually near the spray nozzle) shall fail faster.
   Most competing products that sell cheaper have volumes of 150, 180 or 250 litres. These are all single walled chambers made with cheap acrylic. As is commonly observed, their body and lid joints begin to open up within 6 months of use. Mahip Salt Spray Apparatus uses a sturdily built double walled, insulated chamber made from modified copolymerized acrylic. No joints loosen or open up even after years of service. This chamber alone weighs upto 3-4 times the conventional SST chambers.

2. **Temperature Control – where & how**: Many, rather most of the cheap salt spray chambers control the temperature of the salt solution instead of the chamber atmosphere. Most users are easily foxed by the digital display showing 35 ºC, because often the sensor probe is located in the salt solution reservoir. In such equipment, the temperature of the chamber varies strongly with the atmospheric temperature and relative humidity. For example such equipment have been observed conducting NSS tests at chamber temperature of as low as 12 ºC in winter season, while the digital display indicated 35 ºC!
   For Salt Spray Testing, we at Mahip Industries have analyzed that the reaction rate (corrosion rate) doubles for every 8 ºC rise (for organic coatings, temperature range of 20 – 40 ºC). This means that if we get 10 hrs to fail result for a NSS conducted at 35 ºC, we should get close to 20 hrs to fail for the same specimen at 27 ºC. Consequently, it should be very clear that the test conducted by the cheaper SST chambers are a mere 'eyewash' with no sanctity. The test results of such chambers will always generate confusion and conflict.
   From the above facts, it is very easy to understand it is very, very important to closely control **temperature of the test specimens** where the reaction (corrosion) is actually taking place, and not of the salt solution. The temperature of the test specimens can only be controlled by regulating the temperature of the fog/chamber atmosphere. Mahip Salt Spray chambers do that precisely. For achieving this, insulation of the chamber (double walled) is very necessary. All these increase the cost of the equipment substantially.

3. **Chamber Heating- how**: Use of air-heaters or other heaters inside the chamber as a means of regulating the chamber temperature is prohibited by the international standards because of the following reasons

- Radiant heat from heaters impinges on the specimens and alters the reaction (corrosion) rate.
- Use of heaters inside the chamber is likely to setup temperature gradients inside the chamber i.e. temperature near the heater shall be higher than the farther regions. This again means that the corrosion testing results will vary with the position of the sample inside the chamber, which is not acceptable.

Some of the cheaper chambers use glass encased air heaters to maintain chamber temperature. This is not only prohibited by the standards, but also leads to inconsistent and unreliable results.

Many reputed international brands use **steam injection** as a means of temperature control. This steam which turns to water at the operating temperature of the chamber leads to dilution of the salt solution precipitating on the specimens. It also adversely affects the pH. The steam requirement varies with climatic conditions- more in winter than in summer. Consequently, this type of chambers is also inconsistent in its results, due to issues of varying salt concentration and pH of the sprayed solution.

Still others are recirculating hot water in the chamber walls (or using heaters in the double wall) as a means of heating the chamber. The temperature sensor in such chambers is located near the corners/ edge of the chamber wall. Wall heating sets up temperature gradients, so that temperature near the wall is higher than the middle. Differences of upto 3 -5 ºC have been observed. This again leads to inconsistent results within the same chamber. On the other hand, Mahip Salt Spray Chambers use indirect heating techniques to maintain temperature in the chamber accurately at all points in the chamber. Again, this increases the cost several times.

4. **Humidifier & its level control**: The international standards on salt spray/ fog testing require that the air being used for atomization be humidified by bubbling through a water column of requisite height, and maintained at a specific temperature. This not only raises the temperature of the **incoming** air, but also raises its relative humidity to near 100%. This ensures that the salt concentration and pH of the salt solution remain consistently within the range specified by the standards. Most of the cheaper salt spray equipment do not have a proper humidifier, while a few competing brands offer a very small one. Mahip Salt Spray Chamber is equipped with a 700 mm tall humidifier in SS 304 construction with a microprocessor based temperature control, and more importantly, a SS backup (pressurized) feed tank with an automatic, continuous level control arrangement. Apparently, additional cost inputs are required.

5. **Fog generation & Precipitation rate control**: As is previously known, the salt spray test standards require
    - *The atomizer, made of inert materials, should be capable of delivering a continuous fine mist/ fog by using compressed air at a pressure of 70Kpa to 170 kPa (10- 25 psi)*
    - *Baffles should be provided to a) prevent larger droplets from falling on the specimens and b) prevent direct impact of the spray on the specimens*
    - *The level of the salt solution in the salt reservoir shall be maintained uniformly*
    - *The precipitation rate at all points in the zone where the test specimens are placed shall be 1-2 per 80 sq.cm. per hour over a minimum period of 24/ 16 hours of continuous spraying.*
    - *Test solution which has been sprayed shall not be reused.*

    Cheaper salt spray chambers have imprecise and uncalibrated atomizers (often in SS construction). These are mounted directly inside the chamber usually facing up so that the all the spray hits the roof lid and falls back on the components. Mahip Chambers have a polymer-glass atomizer nozzle that is calibrated for correct precipitation rate. It delivers fog into a spray tower deliberately located at one end of the chamber to maximize loading space especially for longer components. The spray is deflected by a baffle at an angle of 90º, the larger droplets coalesce and drop back while only the superfine mist is allowed into the chamber.

In competing chambers, often no collecting devices are provided as there is no control of precipitation rate. Others have very smartly provided collecting devices at fixed locations where the precipitation rates remain within range due to flow pattern of the spray/ fog. Precipitation rates are markedly different at other points. Mahip Salt Spray Apparatus comes equipped with two collecting devices (for 400 Lts Model) that can be placed anywhere in the exposure zone in the chamber to monitor precipitation rates.

The uniformity of precipitation rates has been a subject of long R & D at Mahip Industries, and is unmatched in industry. This ensures constancy and consistency of test results for all the specimens exposed in the chamber.

In many of the cheaper models offered by competition, salt solution is reused.

6. **Fog Venting**: In Mahip Salt Spray Apparatus, a specially designed fog vent has been provided. It picks up fog uniformly from the chamber, separates the entrained salt solution (which falls into the waste water tank) and lets out the separated fog for venting to atmosphere. This system ensures there is no back pressure inside the chamber, as required by the standards. In cheaper chambers, no fog venting is provided. In slightly better ones, a hole in the chamber wall serves as the vent.

7. **Safety First**: Our experience of over a decade with salt spray testing has underscored the need for preventive controls for consistent testing and prolonged life of the equipment. Very often it has been observed that because the equipment does not require continuous attention during operation, many operators stop paying even the little attention that **is** required periodically. For example, salt solution and/or demineralised water topping up is given a goodbye till a heater (or other) failure results. High system pressures have led to permanent damage to the atomizer nozzles. Consequently, we at Mahip Industries have devised and introduced many novel features to prevent such failures such as those mentioned above. For example, although level gauges are provided on the humidifier and its feed tank, the humidifier is equipped with a water sensor. If the water-level falls below the required level, the heater output is cut-off and a audio visual signal given by the machine, indicating that the water level in the humidifier is unacceptable low. This forces correct operation and also ensures that there are less frequent heater burnouts.

   All such features add to cost but increase the life of the apparatus several times.

8. **Automation for reliability and reduced operator dependence**: Maximum failures are observed following change of operator. The new operator is neither trained in the control of this process, nor usually has the eagerness to acquire proper working knowledge ("Sab chalta hai" attitude). Manuals are often not accessible. In such a scenario, the reliability of the tests and that of the equipment are at stake. Secondly, many operators have been observed to indulge in 'Test Goofing' or 'Doctored Testing'. Chamber temperatures are lowered to increase the life of the specimen, or worse still, a 40 hour OK is reported as 72 hour OK. To counter this tendency, we at Mahip Industries undertook an ambitious project to automate the entire testing procedure and the safety features on one common platform. This was achieved using onboard computerization involving a high speed Programmable Logic Controller, and a 65000, 7 inch colour touch-screen HMI. The program has been painstakingly developed inhouse and subjected to thorough testing, even under different combinations of failure conditions, including power failure.

   The menu driven interactive programming provides interactive instructions to the operator, not only for the operation of the equipment, but also on making the salt solution and other requirements of the standards. This enables even a new user to operate the test properly to the exacting requirements of the standards.

   Besides, the software logs the chamber temperature against date and time every two minutes, for the last 200 hrs. This enables effective **audit** of the test methodology. The duration of the last test planned and the actual test conducted are both recorded. The inspector can cross-check the veracity and authenticity of the testing. Test conducted at lower temperatures, or conducted for shorter periods shall be immediately known.

This automation although done very cost-effectively has led to increase in the cost of inputs.

Mahip Salt Spray Chambers come from process engineering specialists, and not from lab instrument manufacturers. Hence they perform best in process control such as parameters of temperature, precipitation rate and pH consistency. As is well acknowledged in the industry, Mahip Chambers have a life span of 5-7 years as against 1-2 years of the competition, so that if lifecycle costing analysis is applied, these may well turn out to be cheaper than the competition.