The Design and Application of Online Solid-liquid Ratio Measurement Device

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Abstract: The Solid-liquid Ratio in the evaporation tank of the process of Vacuuming salt is inconvenience to measure. The Online solid-liquid ratio Measurement Device was developmented after repeated test and verification.This measurement of the device is accurate, direct and support automatic control system, the market foreground will be considerable.

Key words: solid-liquid ratio; Online Measurement Device; Research and development of device

1 FOREWORD

In the process of Vacuuming salt, measuring the Solid-liquid Ratio in the evaporation tank is aimed at understanding the salt situation in the different evaporation tank, and providing reference for removing (sub-effect) salt timely, Traditional measurement method is mainly rely on manual measurements by the graduated cylinder from the outfall, it is labor-and time-consuming, non-intuitive, great man-made errors. How to design a Online Measurement Device which is economical, practical and real-time reflecting the Solid-liquid Ratio in the evaporation tank, this is what we would now like to discuss. If it were not material constraints, Our company would went about setting out this technological improvements project very early. With the development of science and technology, many new Pressure Transmitter of membrane have come out in succession, so that this technological improvements project has reliable implementation and applications. The following will set forth the design principles, the installation and debugging of this measuring device in order to discussion together.

2 DESIGN PRINCIPLE

We know that If the height h at the same circumstances, the pressure difference $\triangle P$ between arbitrary vertical two points in sealed containers full of liquid(including the solid-liquid mixture) is positive proportional to the liquid specific gravity γ,$\Delta P = \gamma h$. the measurement of solid-liquid ratio in evaporation tank is designed by this principle. In order to verify the solid-liquid mixture also has the characteristic property. We carefully made experiments at the laboratory, recording data and making analysis. Figure 1 is the corresponding diagram based on the proportion between solid-liquid ratio NaCl and the measured values (liquid temperature 12℃) in laboratory. From Figure 1, we can see that the number of solid-liquid ratio in saturated solution NaCl, are positive proportional to the specific gravity of saturated NaCl solid-liquid mixture. From this we can deduce that at the same height, the relationship between solid-liquid ratio and differential pressure of solid-liquid mixture is in linear direct proportion. The idea has been verified.

How to achieve online measurement of solid-liquid ratio? This relates to the selection

and installation location of measuring instrument. As we all know, measurement between two differential points in an airtight container must be selected differential pressure transmitter. To be able to intuitively show the solid-liquid ratio of the measured value, it is necessary to remove the pressure value of the highly saturated NaCl solution under this temperature, known as the "migration" of this differential value, so that this value is then reflected as the percentage of value of this solid-liquid. According to the distance between measurement points, we can calculate the transmitter range of the differential pressure transmitter.

If H=1.5m and the Solid-liquid Ratio is 100%, so the differential pressure in this height is:

$\Delta P1=\gamma h=1.80kg/dm^3\times1.5m=26.47KPa$

The differential pressure of saturated solution is:

$\Delta P2=1.12Kg/dm^3\times1.5m=16.47KPa$

According to reference manuals, we could choose the differential pressure transmitter of measuring range 0-6.2-37.4KPa. because the crystallization of NaCl in the solid-liquid mixture of NaCl crystal easily deposited in the Positive and Negative Pressure interior capacity of Pressure Differential Transmitter, easy to cause elastic deformation of the sensor diaphragm, and measurement error. So when in Selection, it is important to select Isolated Differential Pressure Transmitter device. Through Inspection and contrast, a flange mounted differential pressure transmitter produced by Anhui Lande Zhenghua Electron corporation is more ideal, it is made by Remote device 1199RFW flange-mounted device, silicone oil filling fluid, and differential pressure transmitter components, the flange of flange-mounted devices FarEasTone can match with stainless steel flange of Φ89. NaCl crystal in order to minimize the deposition in pressure tubes, we selected Φ89 stainless steel elbow welded directly to the evaporation tank as pressure tube (Figure 2). The purpose of using Φ89 the stainless steel elbow are, on the one hand, in order to reduce the possibility of pipe blockage of nacl crystals as much as possible. On the other hand, in the car, the air sealed at Φ89 bend, also prevent slurry of salt direct contact with isolation laminated films of flange, thereby enhancing the reliability of job Remote devices.

The types we choose are: 1. flange installed Remote device 1199RFW 11B31A72 (2 set); 2. Filling water is common silicon oil. 3. differential pressure transmitter is LD1151DP4S23B3M392 L=1000mm (PRESSURE extended PIPE) Instrumentation is 316L stainless steel shell for the whole structure, the isolation membrane is the titanium alloy. Its working process is that when the differential pressure between two points A, B changes, the isolation diaphragm of the high and low pressure side and filling of liquid-filled will be transmitted to the irrigation fluid-filled center. Irrigation fluid-filled center will be delivered the pressure to the sensor diaphragm of sensor Center of δ room. Sensing diaphragm is a tension of the elastic element, the displacement changed with differential pressure, the maximum displacement on sensing diaphragm is 0.10 mm, and displacement and pressure is directly proportional. Capacitor plates on both sides detect diaphragm position sensor, and the capacitance difference between the plates and sensing diaphragm is converted into the corresponding current, voltage and digital output signals HAPTR. The isolative diaphragm of remote device directly contact with the liquid medium, It can measure high-temperature, high pressure, strong corrosion, easy crystallization of the liquid medium, precipitation, pressure and density.

In order to observe solid-liquid ratio in the tank intuitively, we selected intelligent light beam display meter LDG3000 light beam displays with light beam and the percentage, so that the operators observer at a glance, intelligent light beam displayer attached to the standard current signal output 4-20mA DC and communication interface RS485, it can be conveniently control systems and PC communications package.

3 INSTALLATION AND PRELIMINARY TEST

pressure measuring point's selection relates to the accuracy and stability of measurement, we follow the principle of choosing points is homogeneous solid-liquid mixture flowing smoothly, less spoiled and easy

to install overhaul in this measurement paragraph. Scheduled location is a vertical section of the next cycle pipe, the length of it is1.5 meters from the two points.

Because the evaporation cans are produced by stainless steel or composite plate, when welding stainless steel elbow Φ89, we should weld it with stainless steel of the tank layer to the extent possible, stainless steel elbow's another port upward, the flange must be welded solid compactly, should not appear sand hole or leakage of water and gas. the best material of gasket between Flanges is material made by PTFE, flange installation must be close, should not appear leakage of gas, so as not to undermine the compressed air isolation of the upper layer of the Φ89 stainless steel elbow.

Installation location of Differential pressure transmitter can be at a suitable location near the tank, the temperature should not too high, and it is easy to install wiring.

preliminary test is mainly the check setting of transmitter, its range is 10KPa; the differential pressure migration of the proportion of NaCl saturated solution generated at this 1.5 meters height is 0, theygenerated by (a specific temperature) different solid-liquid ratio values is the corresponding differential pressure value. In the Work of vacuum salting, the liquid is of different temperature in Ⅰ, Ⅱ, Ⅲ, and NaCl saturated solution is in different proportions, from dissolved NaCl curve, we can see that when the temperature changes, the affect of the solubility of nacl is not large, slightly calculation will be ok. However, in saturated solution NaCl, Na2SO4, NaCl's solubility has large fluctuations (Figure 3), we should carefully calculated temperature in accordance with a liquid and approve and revise by comparing with experiments. If measure the solid-liquid ratio of Na2SO4 in system, we should also carefully calculated the temperature based on the value of Figure 3 to be to avoid excessive measurement error.

Secondary Instrument test is corresponding range 0-100% to the 4-20mA outputted by differential pressure transmitter, it can be intuitively reflect of the value of the ratio of solid to liquid in the tank.

4 CONCLUSION

The applications of Online Solid-liquid Ratio Measurement Device, completely resolved method of measuring solid-liquid ratio in the tank relying on manual for years, thereby reducing the labor intensity of workers, improve the measurement accuracy and, more importantly, it can provide the parameters of automatic control, it achieving the automatic control of adding feed and discharging salt, and has brought new vitality for the modernization of the vacuum salt production.

Reference: Page60 "Panorama of Salinization" by TianLinan LiangHe ZaoYang Salinization Corporation of China Salt