APPLICATION OF ENERGY-SAVING TECHNOLOGY IN THE EXPANSION PROJECT OF CO-PRODUCTION OF SALT AND GLAUBER'S SALT

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Abstract: In the expansion project of co-production of salt and Glauber's salt of Jiangsu provincial jingsheng salt industry, the company adopts the energy saving technology, such as the high pressure return-water for brine exploiting, natural draft cooling tower and single set of high-capacity high-temperature and high-pressure circulating fluidized bed boiler are used, which is the first time for the application in salt making industry in china,. until now, the operation is quite success and achieves the expected effects.

Key words: Co-production of salt and Glauber's salt; energy saving; heat pump; high pressure return-water for brine exploiting; cooling tower; high fluidized bed boiler

1. INTRODUCTION

There are total three sets of salt systems in Jiangsu Provincial JingSheng salt industry. The pots of Ⅰ Ⅱ group introduce the technology of traditional four-effect vacuum evaporation. It can produce actually 450,000 tons every year. The pot of Ⅲ group adopts the device of Co-Production of Salt and Gabber's Salt (CSGS), using of the materials which produce by the pots of Ⅰ Ⅱ group, accomplishing CSGS. Its product of salt is 200,000 tons every year, and the product of anhydrous saltpeter is 30,000 tons per year. Self-configuration of a thermal power is provided with one pressure condensate pump which is 12MW, and including four sets of coal stove which providing 350,000tons per hour.

The project of CSGS responds to the significant strategic which in order to enlarge and strengthen the mineral of wells, and we apply the advanced technology of internal and abroad to it. The scale of construction as follows, refined salt is 100 tons every hour and anhydrous sodium sulfate is 60,000 tons every year. This project starts in June 2006, and put into trial product in August 2007. This project is commissioned to the Swiss SEP for conceptual design, and all the technology is up to the international standards. Some of the key equipments such as circulation pumps, centrifuges, and steam ejector are imported from abroad. This project successfully applies the relevant energy-saving technologies to practice and achieve the desired effect.

2. THE APPLICATION TECHNOLOGY OF HEAT PUMP

Heat pump is an energy-saving device which can make the energy from the low to high by using part high heat. In general, heat pump just like the pump of transferring fluid .It can convert low heat source used indirectly to high heat source used directly. So it will achieve the purpose of energy-saving. Heat pump consumes certain of high potential energy, but the energy of putting out is the sum of consuming and absorbing. Therefore the use of heat of pump installations can achieve obvious energy-saving effect.

Heat pump can divide into steam (electric) compression heat pump, gas compression

heat pump, steam jet pump, absorption heat pump and thermoelectric heat pump in the form. In general, the project of product salt use the steam jet pumps. In the project of CSGS, in total, there are five heat pumps; the first effect uses two heat pumps which are from abroad. The import of specific technical parameters in Table 1

Table 1 Technical Parameters in the inlet of the heat pump

Steam type	Parameters	Units	Design value of	Design value of
Secondary steam of heat pump suction	Volume	Kg/h	22.023	27.460
	Pressure	MPa	0.07	0.08
	Temp.	℃	99.8	104
First steam of heat pump kinetic	Volume	Kg/h	31.801	55.608
	Pressure	MPa	0.45	0.45
	Temp.	℃	150	150
The steam of mixed emissions(heat pump)	Volume	Kg/h	53.824	83.068
	Pressure	MPa	0.12	0.15
	Temp.	℃	99.8	104

The steam jet heat pump use the evaporation of 230℃,and 0.45MPa as the motive power, then produce the secondary steam which temperature is 104℃,the pressure is 0.07～0.09MPa. Producing 0.15MPa, 130℃of mixed steam, then put into the heating room re-entering the salt and saltpeter. At the same time, using the first of thermal power plant giving the 0.45MPa, 230℃ of steam as a vapor into the salt, the heating chamber to maintain the thermodynamic cycle Because that it imports the high-performance steam jet pump, and pumps a large number of secondary steam from brine, so we can make full use of the system heat, reduce the energy efflux in the system. The same device less use of the salt production steam 20%. The pre-production testing results that the existing production facilities significantly lower the energy consumption and energy-saving effect. The current consumption of the device system every tons of salt steam consumption dropped to 0.8～0.9. Thermodynamics process of steam-jet pump in the enthalpy-entropy diagram show in Figure1

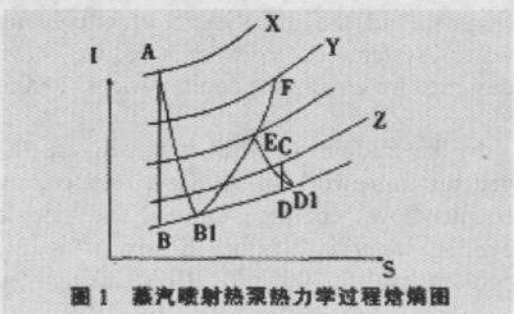

图 1 蒸汽喷射热泵热力学过程焓熵图

X curve diagram represents the pressure of a steam-driven steam line, Y output curve represents the mixed vapor pressure line, Z curve represents the secondary vapor pressure line of inhalation. A represents the state of steam-driven point, B represents the export pump nozzle ideal point, B1 represents the point of the actual state at the nozzle. C represents the state of steam of inhalation point. Steam in the run-time drives through the nozzle expansion from A to B1, the inhalation of steam is from the C point of expansion to the D 1 point (B, D is the ideal expansion point). Two steam currents rise through the mixing chamber to the E-point, and then through the diffuser to the state of boost exports F.

From the figure of the enthalpy-entropy, it can be seen that the steam inhalation of the steam-driven step-up kinetic energy based on the step-down driven. The process of mixture steam accords with the momentum equation of the process.

3. THE ENERGY-SAVING TECHNOLOGY APPLICATION OF THE HIGH-VOLTAGE TRANSMISSION AND ADOPTING ABOUT BRINE

The distance of Jiangsu Province Salt Industry between brine mining and products area is 7 km. Three sets of the original system, mining and transportation peer-halogen program is same with their peers. The three systems contain 600,000 tons raw materials.

Production brine go through the brine pipe convey from the mining area to the Corporation. The source of brine is from wastewater that treatment and treated wastewater. It transits two 220 KW DF-280-43*4 wasted water and return water pipeline to the mine's mining brine pool. Setting in the mining area is four 132 KW DF46-50*10 and four 250KW DF 85-67*8.Brine pump by which brine water will be taken through the adoption of Brine pump. Produced brine through the brine pump and losers brine Pipeline, Used for normal production. Power equipment in the mining area is far away from the company, so we need purchase of electricity from power companies and spend expensive electricity money, the average is 0.69yuan / kWh. When completion of our original ,there are three systems containing 600,000 tons of raw materials production, needing the total power is: 2200 kW(Brine 1700kW). Pump models, the amount of power in table 2

Table 2 Model and Amount of the pumps in transporting the brine

Pump No.	Pump Model	Power model and rated power	Amount
1-2	DF-280-43*4	Y355M-4,220KW	2
1-3	DF46-50*10	Y315M-4,132KW	3
6	DF46-50*10	Y315M-4,132KW	1
8	DF85-67*8	Y2-355M-,250KW	1
10	EMC80(I)*8A	Y235511-2,250KW	1
12	DF155-67*8	YKK450-2,450KW	1
13	DF85-67*8(B)	Y23551-2,280KW	1

In order to make full use of combined heat and power resources of the company. , We have decided to introduce a new technology which firstly in the domestic salt industry : combining the brine pump and back to pump, removing waste water pumps, pumps will be installed in Brine Plant salt factory, using high-pressure return. The normal pressure of brine water pipe improves from 1.0 MPa to 6.5 MPa. Using the L360 high-pressure spiral weld material tube, at the same time, it uses of Brine pump pressure to overcome the pressure loss of backwater channels. New pump is three Selection 1400kW high-pressure pump, ModelDF500-140*5, flowQ=500m^3/h, head 6.5MPa. It supports the use of 6kV electric high-voltage motor, meets the old systems 650,000 tons/year and the new Engineering 800,000 tons/year for the actual salt brine production demand. The actual pump operation of power is 2800kW. The original set in the old mining area is used as standby pump or changing peak pump.

4 THE APPLICATION OF NATURAL DRAFT COOLING TOWER TECHNOLOGY

Multi-effect vacuum evaporation of salt small circle of art at the end of the heat-effect evaporation system of the secondary steam must be condensed into water to complete the task. The system generally uses mixed atmospheric condenser. The cycle water adopts closed-cycle cooling towers, because it contains certain chloride ion which pollutes the water. Cooling tower use the contact between water and air, while (high-enthalpy value) water sprinkles from sprinkling water system to the broadcast tower. When the water droplets and air contact, because the direct heat transfer, what's more, because the difference pressure between surface and air water vapor, it presents the phenomenon of evaporation taking away the evaporative heat ,then cool down the temperature. In order to achieve the purpose of cooling process, dry (low enthalpy) air gets into the cooling tower, because of the static pressure, so water molecules continue evaporation to become water vapor molecules. Then the temperature decline in cycle water. Most of them use salt enterprises Mechanical forced ventilation tower, in order to save energy, we use hyperbolic cooling towers. While new projects-atmospheric water condensers-need cooling water 6000m^3 /h, considering the summer and the old system of circulating water system of convergence, we have designed for circulating cooling water12000m / h.

In the traditional method, it will use the general framework of reinforced concreting counter-flow cooling tower. The single cooling water is 2000m^3/ h (six) or single cooling water 3000m^3/h (four).taking the

second for example, if the design of putting in water temperature: t_1 = 43℃, temperature of putting out of water t_2=33℃, temperature droping △t= 210℃ (cooling towers), atmospheric pressure: P = 101Pa, dry-bulb temperature 34.3℃, relative humidity 59%.The proportion:1.08 kg / m^3 enthalpy of air into the tower86.491 kJ/kg, putting in water and out of water, the average temperature of saturated air enthalpyi_1 = 166.301 kJ/kg,i_2 = 110.779 kJ/ kg, i_3=135.943kJ/kg. Evaporative cooling coefficient k= 0.9447, by the thermodynamic calculation it can exchange number of N. According to the choice of cooling tower fill and filling materials, it can know N. In double logarithmic coordinates, gaining the λ~ N, the λ~ N' curve, the intersection condition is the cooling tower for the small point, λ= 1.05, the corresponding air volume fan G = λ* Q /λ dry = 236.913*104 m^3/ h .According to the mean wind speed Vm and q ,we use the single axis power 160kW.and the design for circulating cooling water is 12000m^3 / h. In the traditional method, the need for total power is 640 kW motor capacities. Using hyperbolic cooling towers of natural ventilation takes place of natural ventilation Mechanical ventilation to save energy.

5 THE APPLICATION OF SAVING-ENERGY TECHNOLOGY MATCHING THERMOELECTRIC

In our company, there are pairs of thermoelectricity stations for the 4 sets of 35t / h boiler furnace stoker chain, one 12MW pumping condensate mid-temperature pressure-type cogeneration unit. The maximum steam production of the unit steam turbine is the 80t/h, which requires the warm redactor to meet the need of production. This glauber's salts successional production and extension project uses circulation fluid bed boiler of 240t/h adopted the high temperature high pressure parameter design stove effect 90.08%, Substituting for old boiler furnace stoker chain whose original design stove effect was 81.8%. The efficiency of boiler raises 16 percentage compared to the original craft by abandon boiler furnace stoker chain in existence. New, old furnace heat consumes the same coal, ash, slag decrease of carbon content, at the same time it plays a high parameters, high-capacity energy-saving advantages. The old 12 MW coagulator adjustable exhaust-type gas turbine exhaust steam after power generation, then must be partly entering the condenser, there is a great loss of the cold source. The new generation power plant turbine selection of 30 MW back-pressure high temperature and high pressure extraction units, power plant turbine exhaust steam after power generation directly for all the salt used. The original 12 MW adjustable pressure turbine reduce the cold-source group and improve the loss of the use of energy efficiency.

By optimization, the average heat of the old system is 100t /h, the largest is 15t /h. Extraction pressure rated to 0.8～1.2 MPa. Therefore, there is one device that making it decline from 3.82 MP a, 450℃ to 0.98MP 260℃,resulting inefficient energy use. We have 30 MW high temperature and high pressure extraction back-pressure less-pressure selection parameter 0.4～0.6 MPa. 260℃, the preparation of the basic parameter is the steam pressure pump parameters and the import of steam heating steam room added parameters, resulting the temperature regulator, realize the high efficiency of energy consuming

6 ECONOMIC ANALYSES

In August 2007, we began to put the salt-generation expansion project into practical product. The comparative analysis between the production indicator and consumption indicate that the actual production data formed from November to December recently are as follows

Table 3 Comparison of Energy Consumption

	Index Name	4th Quarter(2006)	4th Quarter(2007)	Note
Primary energy input	Raw coal(ton)	52406	82097	Statistic
	Standard coal(ton)	38951	61249	Calculated
production	Salt production(ton)	188290	450047	IV()251361
	Generating capacity(million degrees)	2439	3115	Statistic
	Internet capacity(million degrees)	1493	65	Statistic
	Salt consumption(million degrees)	662.19	2241(427 for brine)	IV(1215)
Product consumption	Coal consumption(kg/ton)	175	135	Calculated
	Electronic consumption(degree/ton)	51.02	51.5	Old system
			31.34	New system
	Steam consumption(ton/ton)	1.21	1.195	Old system
			0.82	Old system

Companies do not buy electricity from the Internet. Speak only from the energy consumption of primary energy consumption of the coal. The exported production that company mainly transformed are electricity used in internet, salt and a by-product of gentrification .So, from the table, we can see that after the test engineering of the production of salt and sodium in 2007, in fourth quarter, primary energy equivalent of coal consumed more than 22298 tons, less than 1,428 million kWh of electricity used in internet, but explicitly product salt more than 26.1757 million tons compared with the same period of last year. With the further analysis, calculating according to indicators of power supplied with the standard coal consumption over the same period 393 g /. In 2006, the production of salt is 188290 metric tons and consuming standard coal 33,084 tons; standard coal consumption of the integrated salt is 0.175 tons / ton. Four quarter salt in 2007, produce 450,047 metric tons and consume standard coal 60,994 tons. The Comprehensive standard salt consume to 0.135tons/ tons. The explicit data tells us that after the completion of projects, energy-saving technological advantage has translated into economic advantages for large-scale production of device technology, intensive and large-scale effects appear after the completion of new projects of labor productivity. Energy consumption and cost have a higher level than the existing devices.

7. CONCLUSIONS

Salt-generation expansion project in the selection of equipment use for high-power high-voltage electric motor and VVVF hydraulic coupling technology, there are a number of energy-saving technology program at present, the state attaches great importance on the work of energy-saving emission reduction, the situation that energy-efficient enterprises are facing are extremely grim, Salt Industry Co. in Jiangsu Province, Ltd Well gods Salt and supporting the expansion of cogeneration technology projects to implement the guiding ideology of Salt Company in the "salt of industrial technology policy points" that the "vacuum to develop large-scale salt production facilities, combined with the technological transformation of some enterprises to increase salt production, single set of equipment capabilities, substantial increase in labor productivity, economies of scale close to the international level, reducing power consumption and cost, improving economic

efficiency , as well as in the" structure of the National Salt Industry adjust the view "that. "Well mineral production equipment to a single set of large, multi-effect of the direction of the development of economies of scale, sulfate-type salt should be a gradual move towards the production of salt and sodium-generation technology," the technology roadmap. Although the engineering part of the application of energy-saving technology to be further verified, but the scientific and technological progress is the salt industry's main way of scientific development, Jiangsu Province Salt Industry Co., Ltd. Well God through multi-year research demonstration, building and supporting cogeneration Salt works well mine is to salt from salt into energy-saving energy-hungry big business should assume social responsibility, improve their core competitiveness and build a resource-conserving and environment-friendly high salt unified enterprise modernization.