WORLD SALT SYMPOSIUM

June 19-21, 2018 Park City UT, USA

Study on Wet Flue-Gas Desulfurization (FGD) Process in a Thermal Power Plant using Salt Slurry from Brine Purification

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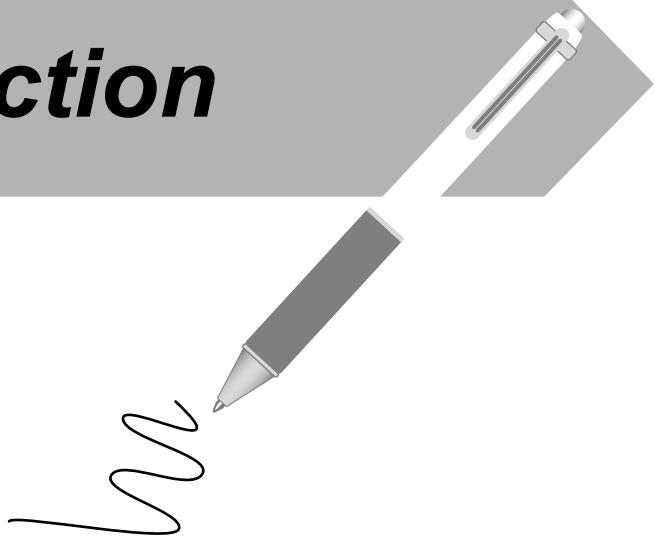
1 Introduction



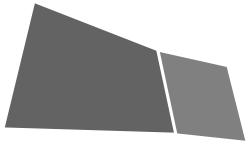
Company Introduction

- Benchmarking Enterprise of Chinese salt industry
- The first High And New Technology Enterprise in Chinese salt industry
- National Enterprise Postdoctoral Research Station
- Lu Qiang Academician Workstation
- Technology Conversion and Application Center of CNSIC



Brine purification & salt slurry

Brine purification, also called the pretreatment of brine, is one of the critical step during salt-making. The aim of the brine purification is to separate the ions such as Ca^{2+}、Mg^{2+} from the raw brine before entering the heating chamber. The inorganic salts that are discharged in this process is termed as "salt slurry". China's output in 2017 was about 2.23 million tons.



Salt slurry

- Large output ~ 2.23 million tons in 2017
- Low added value
- Serious waste of resources
- High processing costs ~ $10
- Cause secondary pollution ~ solid waste

→ A common technical challenge in the domestic salt industry.

1、absorb

$$SO_2 + H_2O \rightarrow H_2SO_3$$

2、Neutralization reaction

$$CaCO_3 + H_2SO_3 \rightarrow CaSO_3 + CO_2\uparrow + H_2O$$

3、Oxidation reaction

$$2CaSO_3 + O_2 \rightarrow 2CaSO_4\downarrow$$

Salt slurry → **limestone** → **Wet FGD**

resource recycling and utilizing

Neutralization reaction

$$\mathbf{CaCO_3} + H_2SO_3 \rightarrow CaSO_3 + CO_2\uparrow + H_2O$$

Synergist

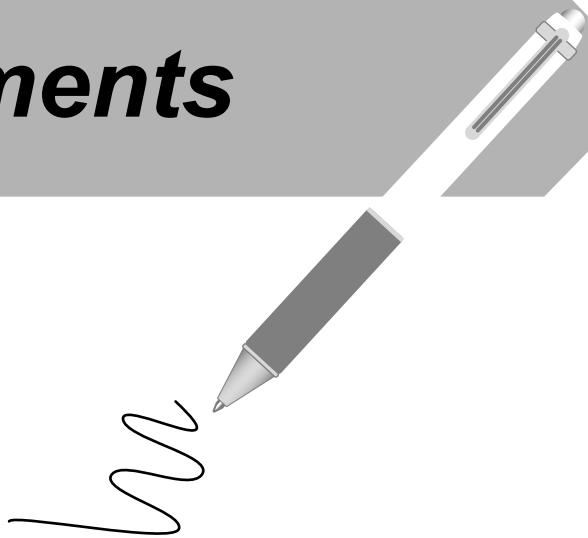
Salt slurry + R-COOH → $(R\text{-}COO)_2\text{-}Ca$ + $CO_2\uparrow$ + H_2O

$(R\text{-}COO)_2\text{-}Ca$ + H_2SO_3 → $CaSO_3$ + R-COOH + H_2O

intermediate product

Synergist can significantly improve the absorbing rate of the salt slurry and boost its activity.

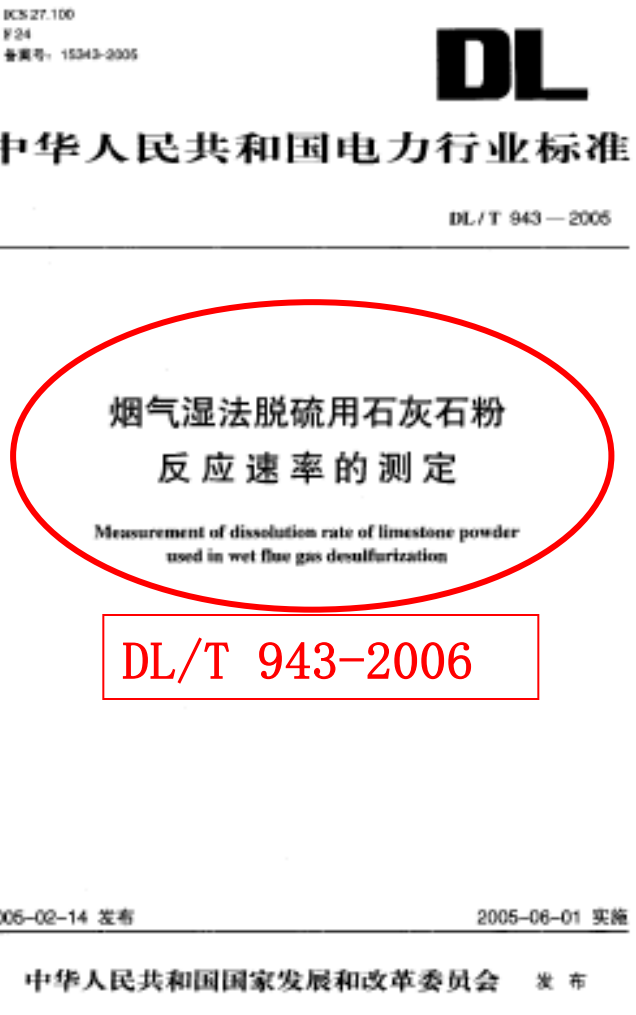
2 Experiments



Test methods

The finenesses of salt slurry and limestone are 250 mesh with 5% residue. In experiment, taking 250 ml of 0.1 mol/L $CaCl_2$ solution with a measuring cylinder and add it to a beaker and heating it in a water bath to a constant temperature of 50°C. Then, 1.50g salt slurry or limestone weighted with an electronic balance was added it into the beaker and stirred for 5 minutes with a rate of 800r/min. The detailed method is described as follows: Putting the pH value electrode into the suspension solutions that is waiting for measuring, and the electrode should never touch the agitation blade. Setting the automatic pH titration at 5.5. Starting titrating with the hydrochloric solution of 1.0 mol/L and then timing. Recording the consumption of the hydrochloric acid at different times. The consumption of the hydrochloric acid will be used to reflect the desulfurization activity of the salt slurry.

Test standard


ICS 27.100
F 24
备案号：15343-2005

DL

中华人民共和国电力行业标准

DL / T 943 — 2005

烟气湿法脱硫用石灰石粉
反应速率的测定

Measurement of dissolution rate of limestone powder used in wet flue gas desulfurization

DL/T 943-2006

2005-02-14 发布 2005-06-01 实施

中华人民共和国国家发展和改革委员会 发布

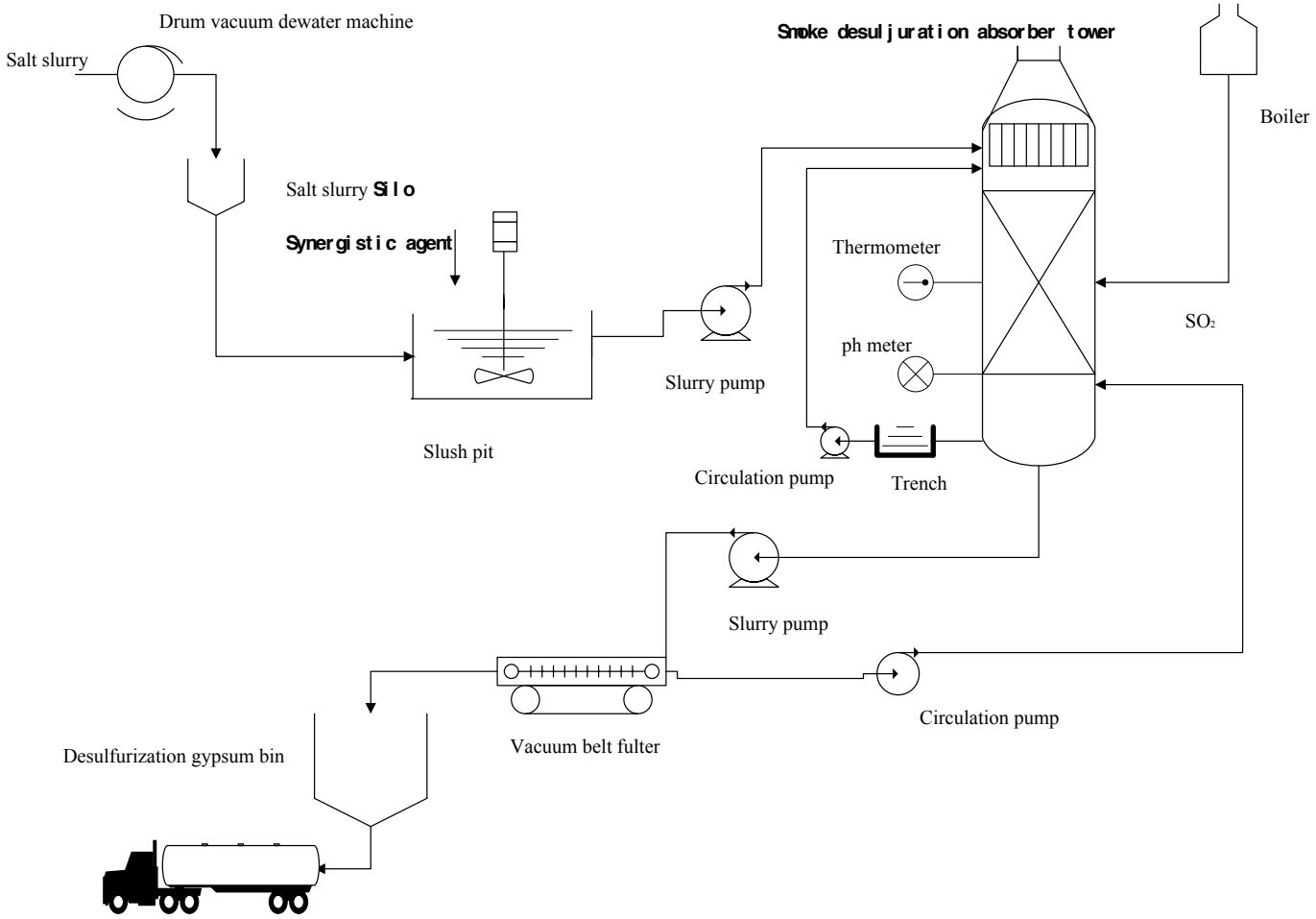


Fig.1. Process flow chart of salt slurry desulfurization system

3 Results and discussion

Characterization of physicochemical properties for the salt slurry

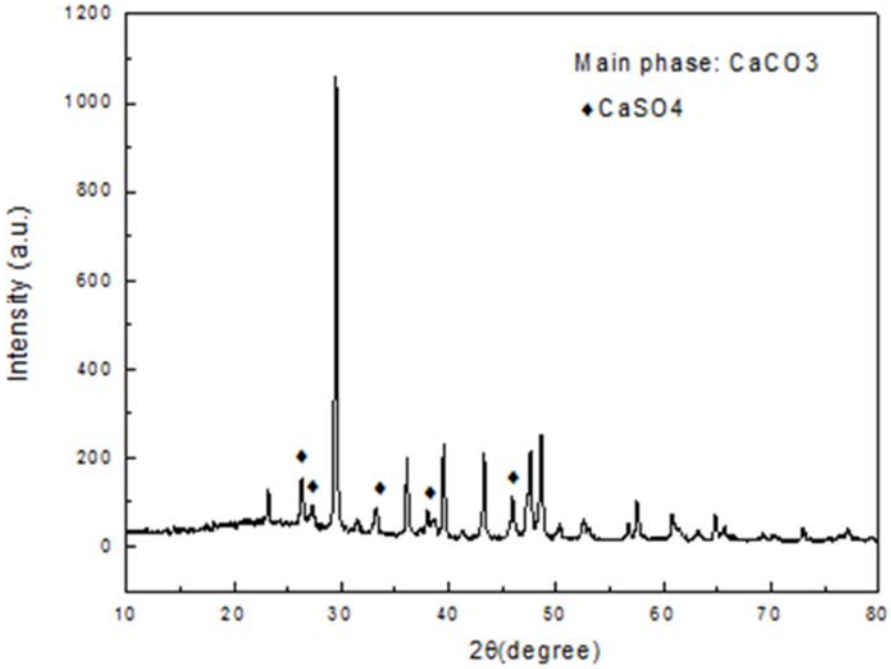


Fig.2. XRD of salt slurry from brine purification

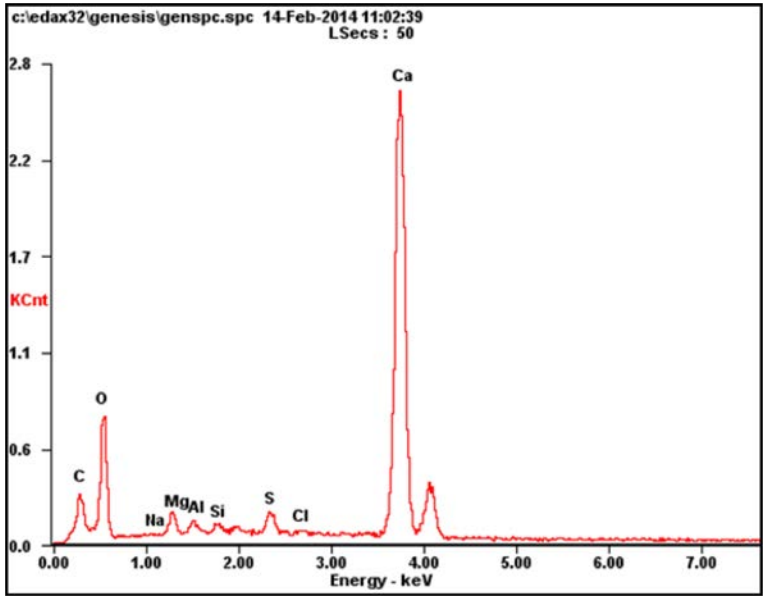


Fig.3. EDS of salt slurry from brine purification

Performance of salt slurry as desulfurization

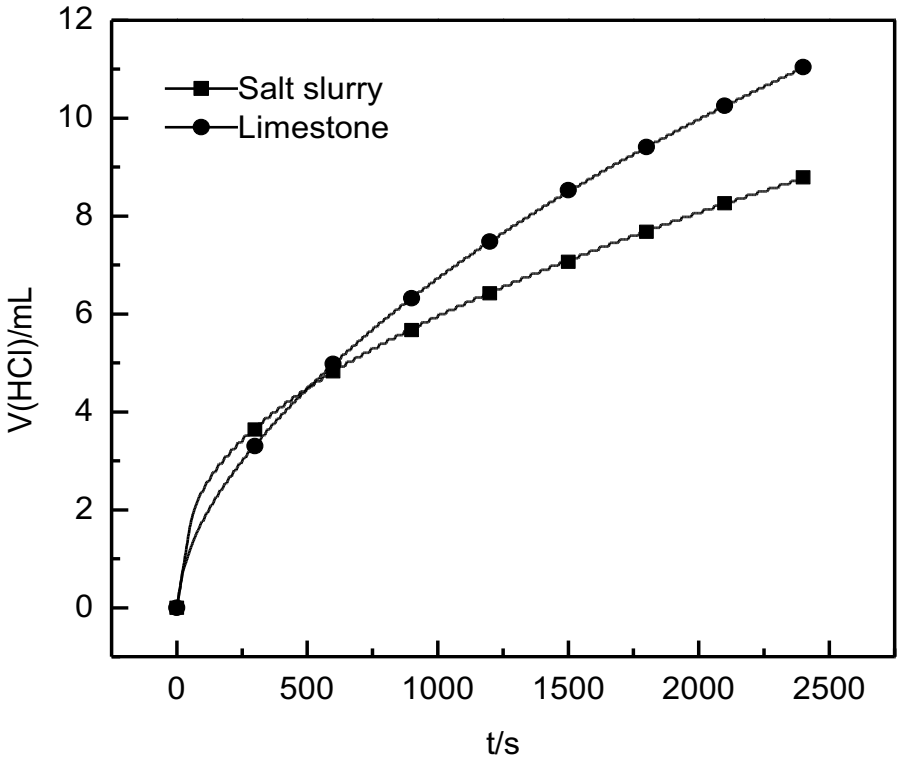


Fig.4. Wet FGD rate for the salt slurry and limestone

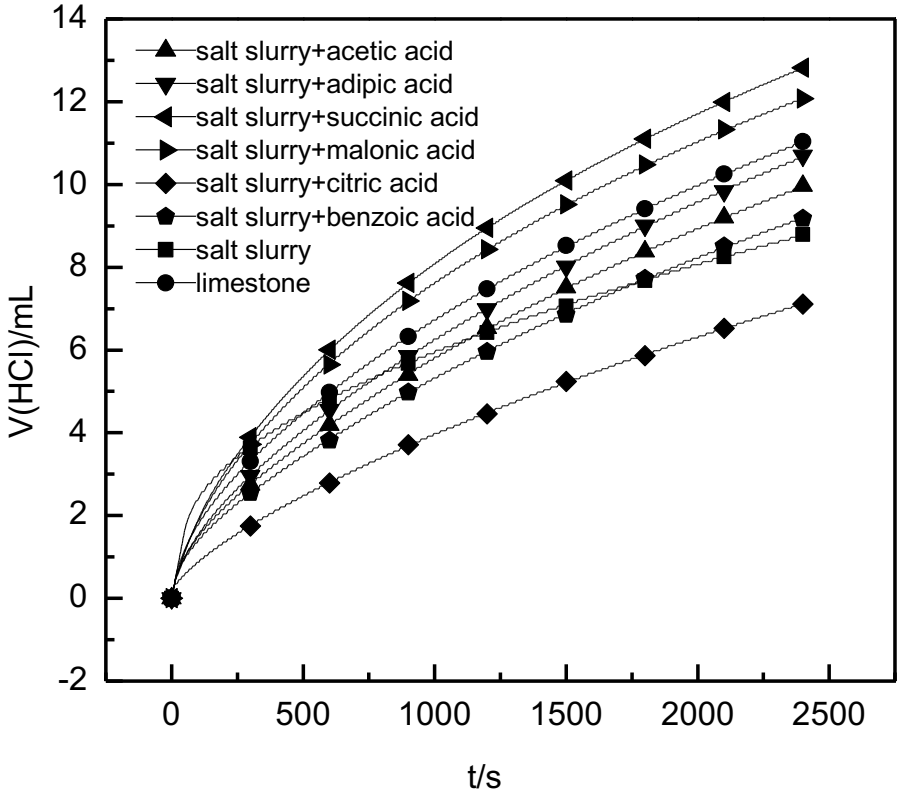


Fig.5. The consumption of the hydrochloric acid for the salt slurry with organic acid synergist

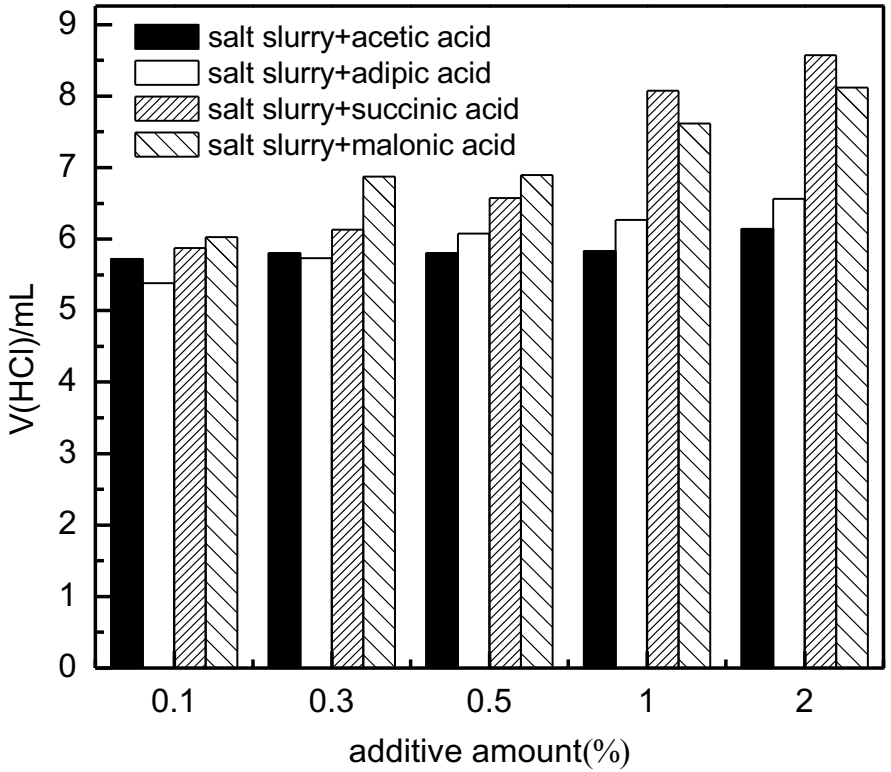


Fig.6. The consumption hydrochloric acid
for the salt slurry with different dosages of 4organic acids（t=1000s）

Industrial experiment of salt slurry desulfurization

Table1 Wet FGD efficiency of different desulfurization absorbent slurry
reference：using limestone to prepare 15% slurry

Name	time	SO_2 concentration before desulfurization (mg/Nm^3)	SO_2 concentration after desulfurization (mg/Nm^3)	Efficiency（η）
salt slurry	2016. 2	1345	76	**94.30**
Salt slurry+formulaA	2016. 3	1332	29	**97.83**
Salt slurry+formulaB	2016. 3	1348	26	**98.07**
Salt slurry+formulaC	2016. 4	1386	30	**97.84**
Salt slurry+formulaD	2016. 4	1428	25	**98.25**
Salt slurry+formulaE	2016. 5	1395	33	**97.63**
reference	**2016. 1**	**1393**	**43**	**96.91**

Table 2 The component analysis of the gypsum after using 3 different raw material for desulfurization

Gypsum Components	limestone	salt slurry	salt slurry + formula D
W H_2O/%	28.76	33.04	21.64
W$CaCO_3$/%	7.03	6.84	0.21
W$CaSO_4$/%	44.82	42.23	65.68
W$CaSO_3$/%	14.17	13.68	6.94
WCl^-/%	0.37	0.43	0.28
Wss/%	4.85	3.78	5.25

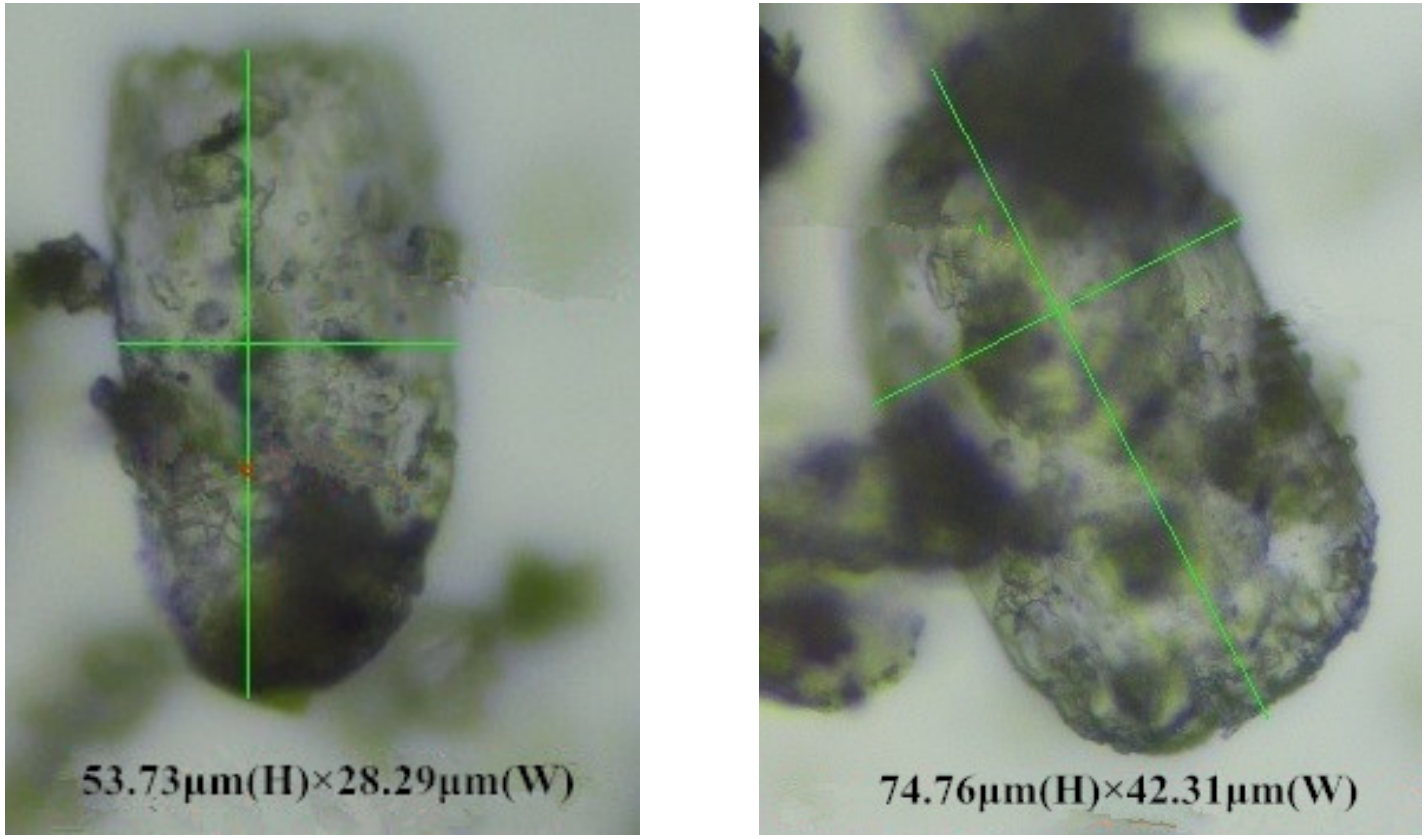
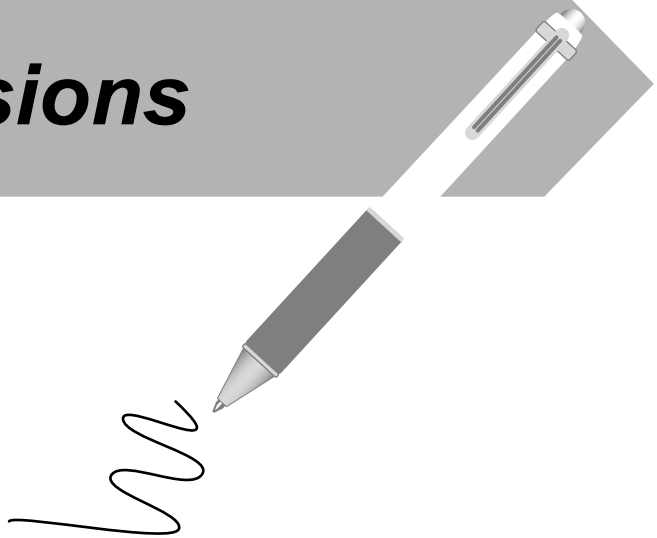


Fig.7. The particle size of the gypsum after adding organic acid synergist

4 Conclusions



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Technological innovation

By taking advantages of combining the salt slurry with the organic acid synergist, a new type of salt slurry as the raw material for wet FGD can be developed. The addition of some organic acids can greatly increase the desulfurization efficiency of the salt slurry.

Resource recycling

The application of wet FGD in power plant, solves the problem of slurry treatment for the salt industry by saving the cost of backfilling the slurry into the wells and recycling the salt slurry resources.

Environmental resources protection

If the desulfurization gypsum can be sold as the raw material, the comprehensive utilization of re-sources can be further enhanced. In addition, the total desulfurization system can run in long-term stability.

Significant benefits

This technology greatly reduces the desulfurization cost of the power plant, saving the consumption of limestone and protecting the resources. The research in this study achieves the target of treating waste by waste and the developed process has great potential for spreading and application.

Production site photos

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THANKYOU

THANKS FOR WATCHING THIS PRESENTATION