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Nitride determination in black dross

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Content

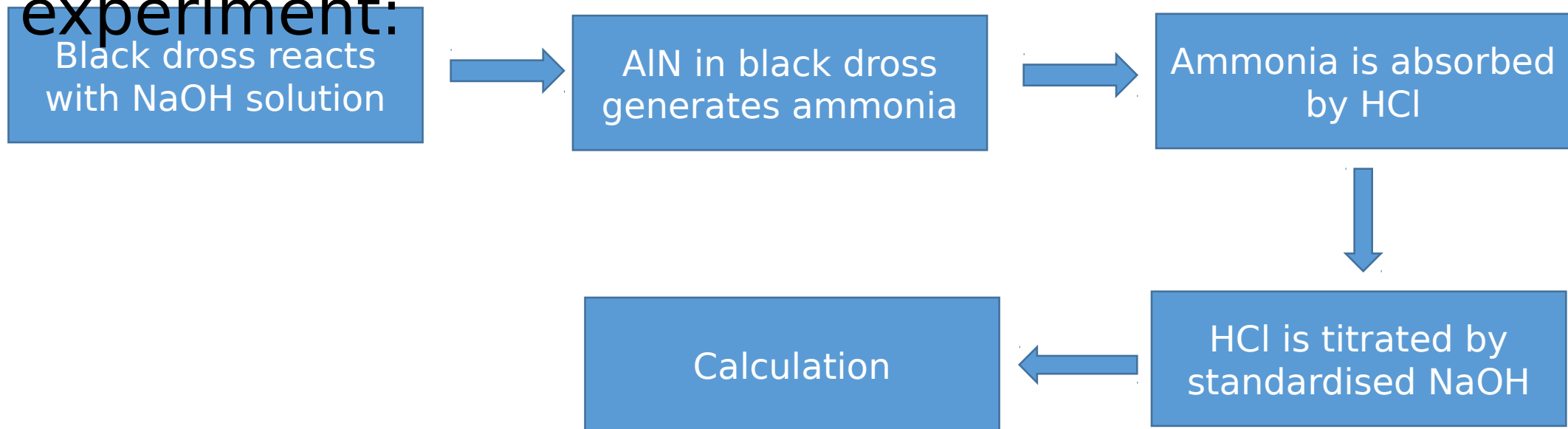
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Background

- Black dross contains AlN phase. AlN is a problematic phase, since it is very sensitive to moisture and water producing harmful, poisonous, and unpleasant odorous gas – ammonia.
- Black dross consists of high amount of salts which can be recycled for multiple purposes. Water leaching is commonly used to extract salts from black dross. However, this process may generate considerable ammonia due to the existence of AlN. Therefore, novel methods need to be developed to accurately determine the content of AlN in black dross. Only in this way can we design specific methods to treat ammonia problem during leaching process.

Experimental

Procedure of the experiment:



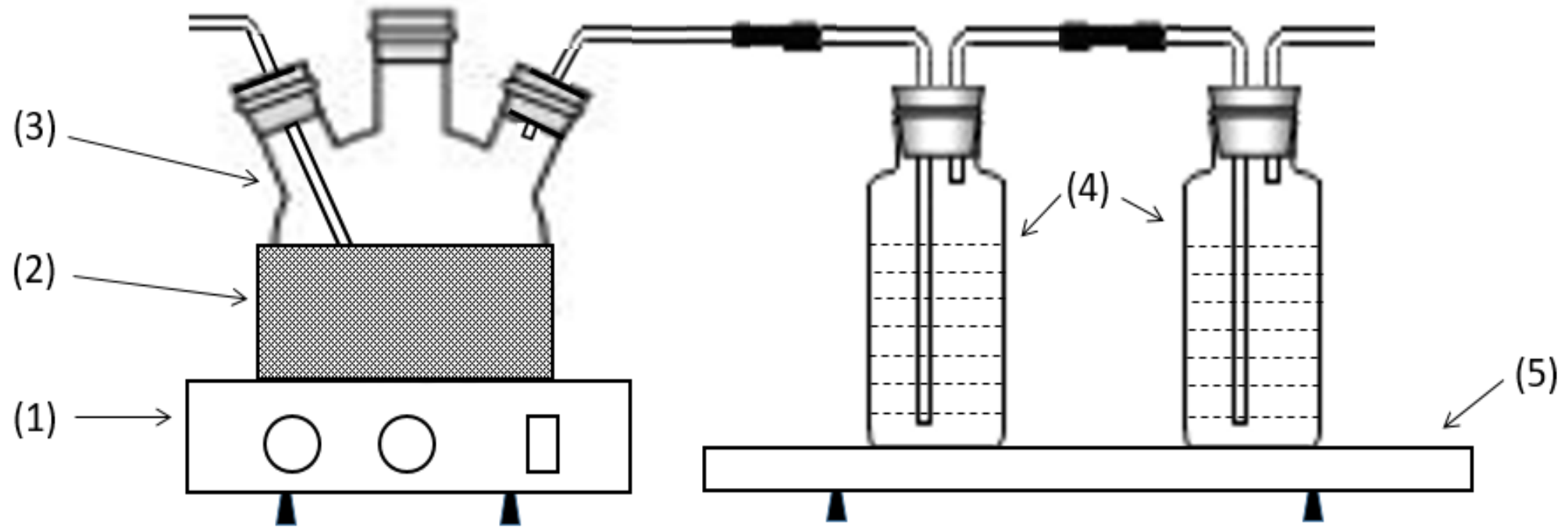
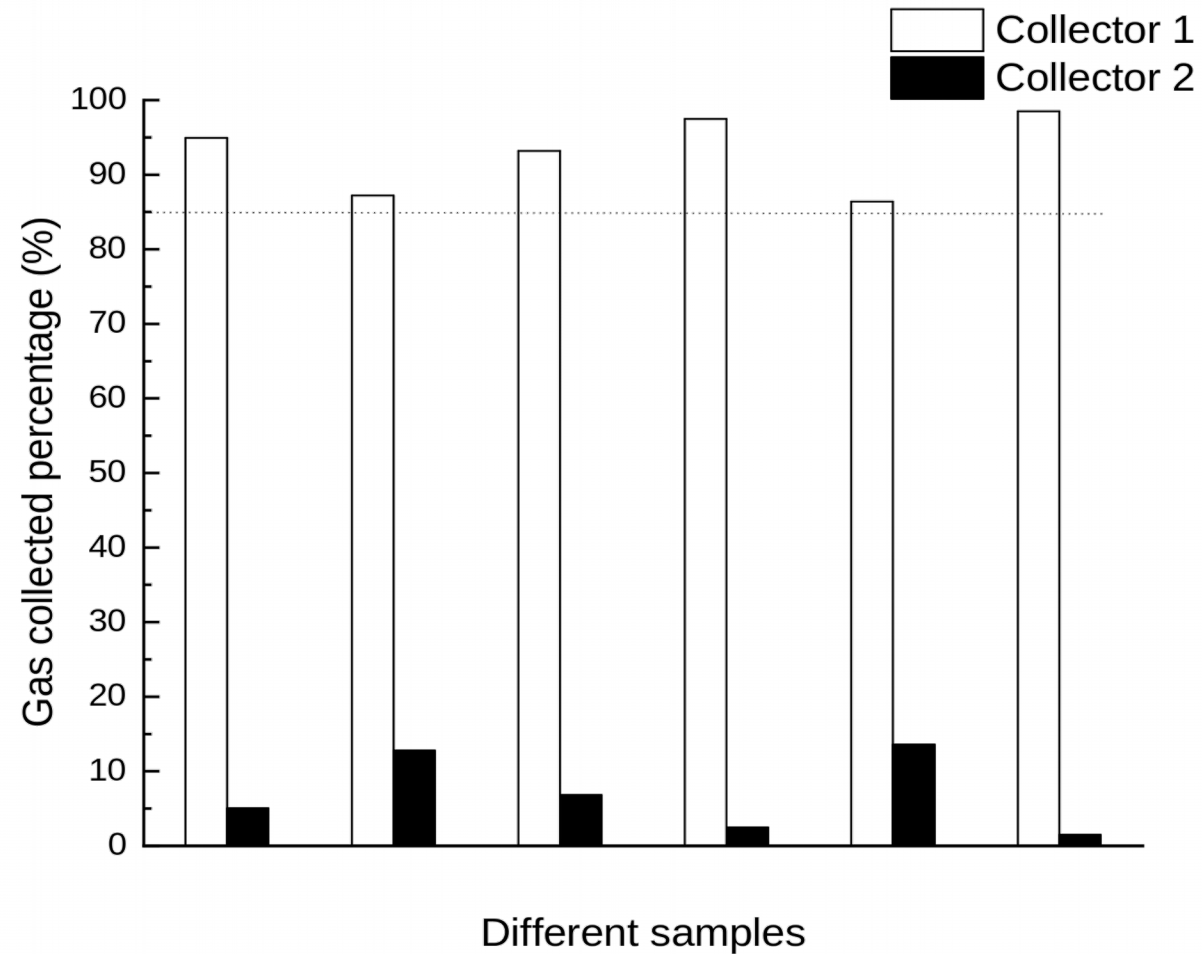


Fig. 1 Main leaching experimental apparatus (1) Digital magnetic stirrers with heating, (2) Metal holder, (3) Three neck reactor, (4) Bubbles, (5) Retort stand

The efficiency of gas collectors:



the first collector
can absorb over
85% ammonia gas

Fig. 2 Gas collected percentage of two collectors

Results and discussion

The effect of temperature and stirring:

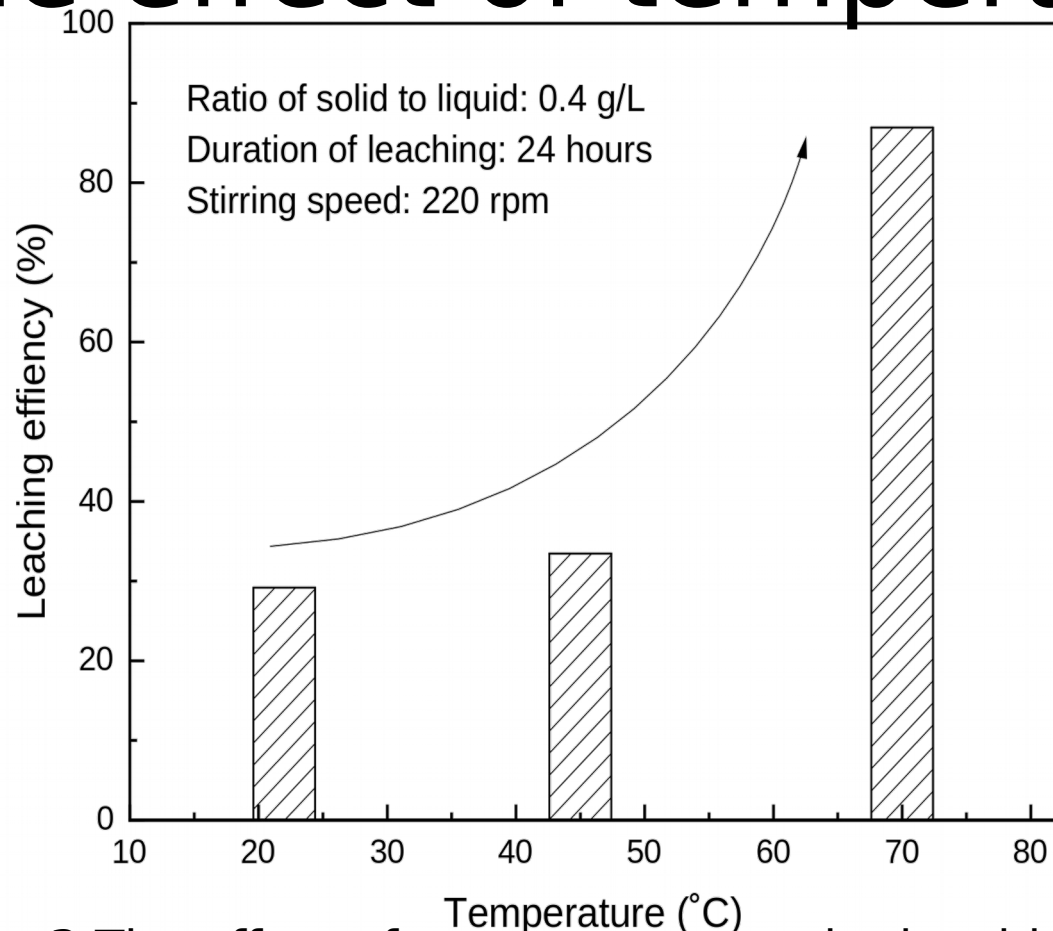


Fig. 3 The effect of temperature on the leaching efficiency (using pure AlN as a bench mark)

Temperature: 70 °C

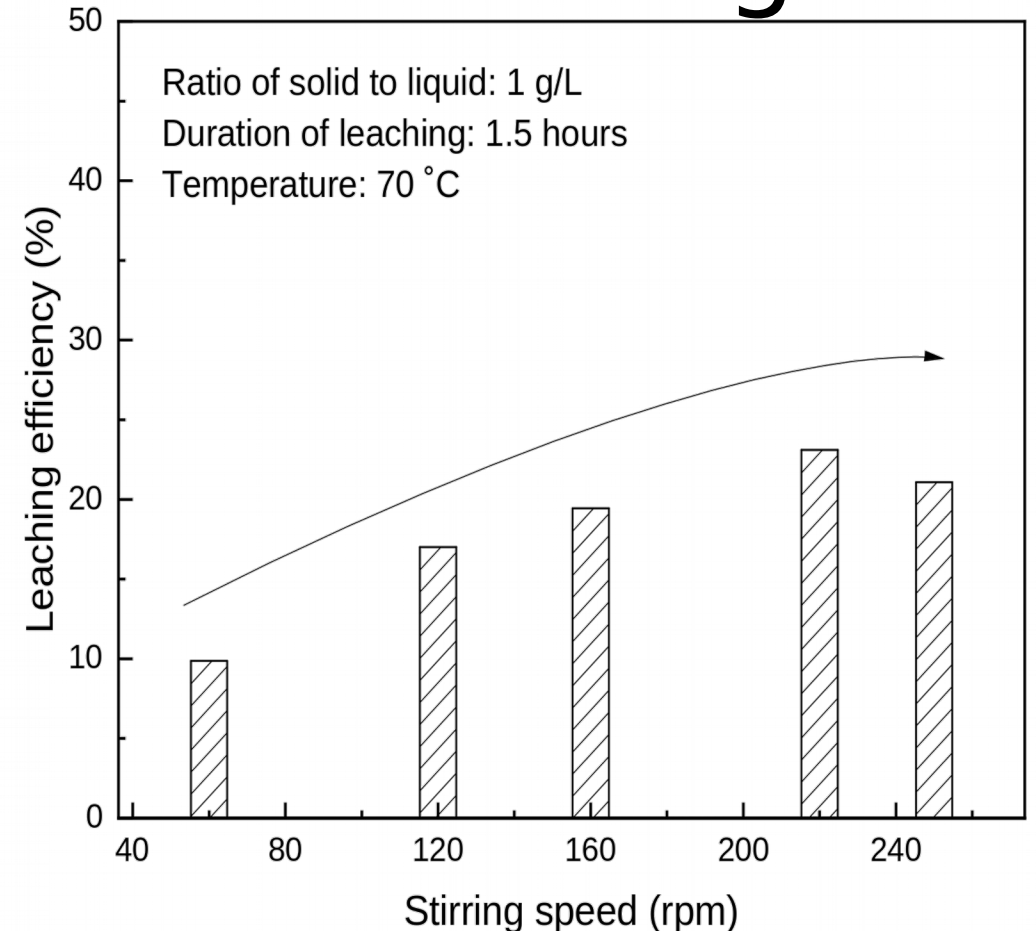


Fig. 4 The effect of stirring speed on the leaching efficiency (using pure AlN as a bench mark)

Stirring speed: 220 rpm

The effect of ratio of solid to liquid:

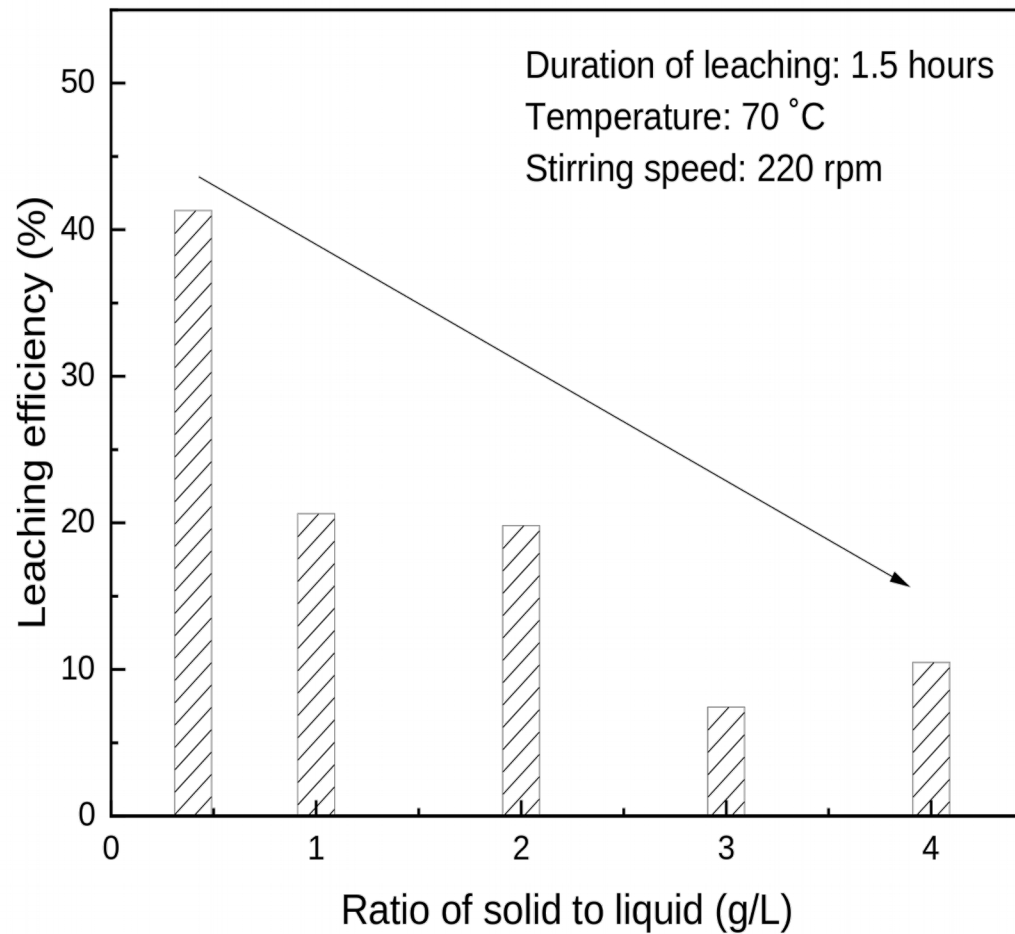


Fig. 5 The effect of the ratio of pure AlN to liquid on the leaching efficiency

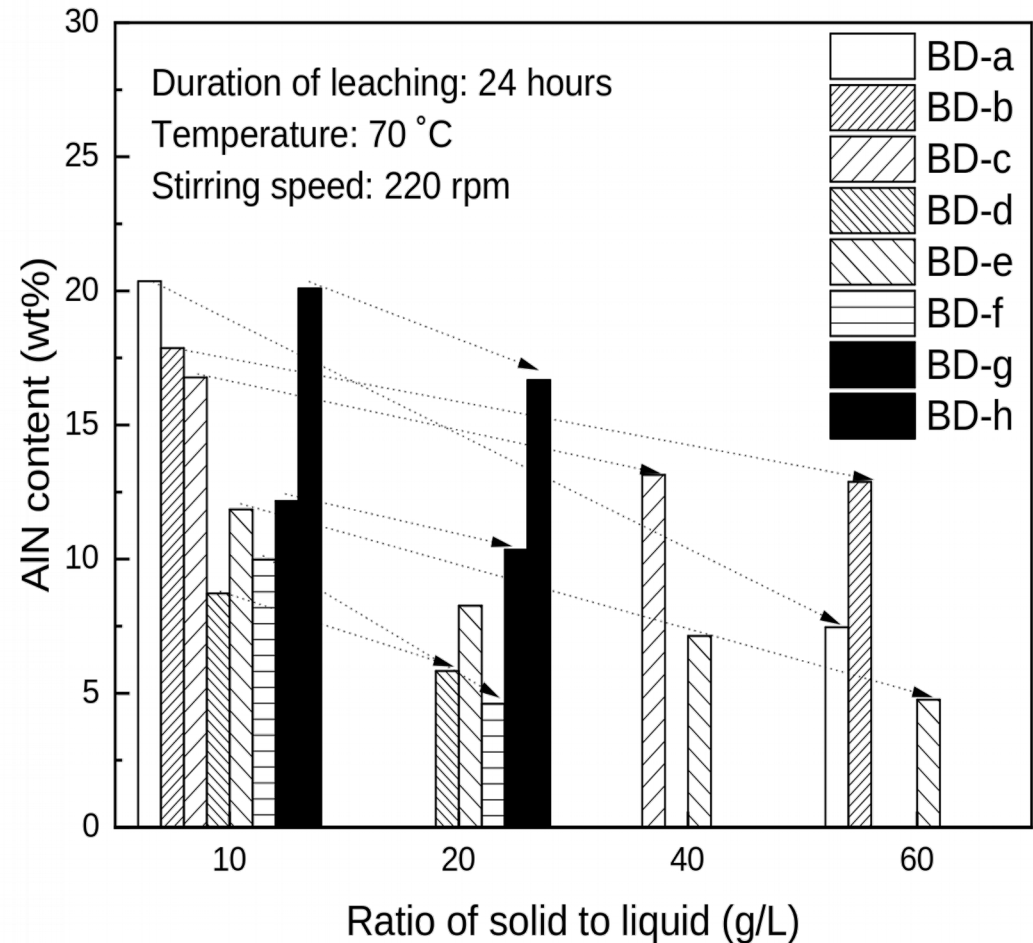


Fig. 6 The effect of the ratio of black dross to liquid on the leaching efficiency

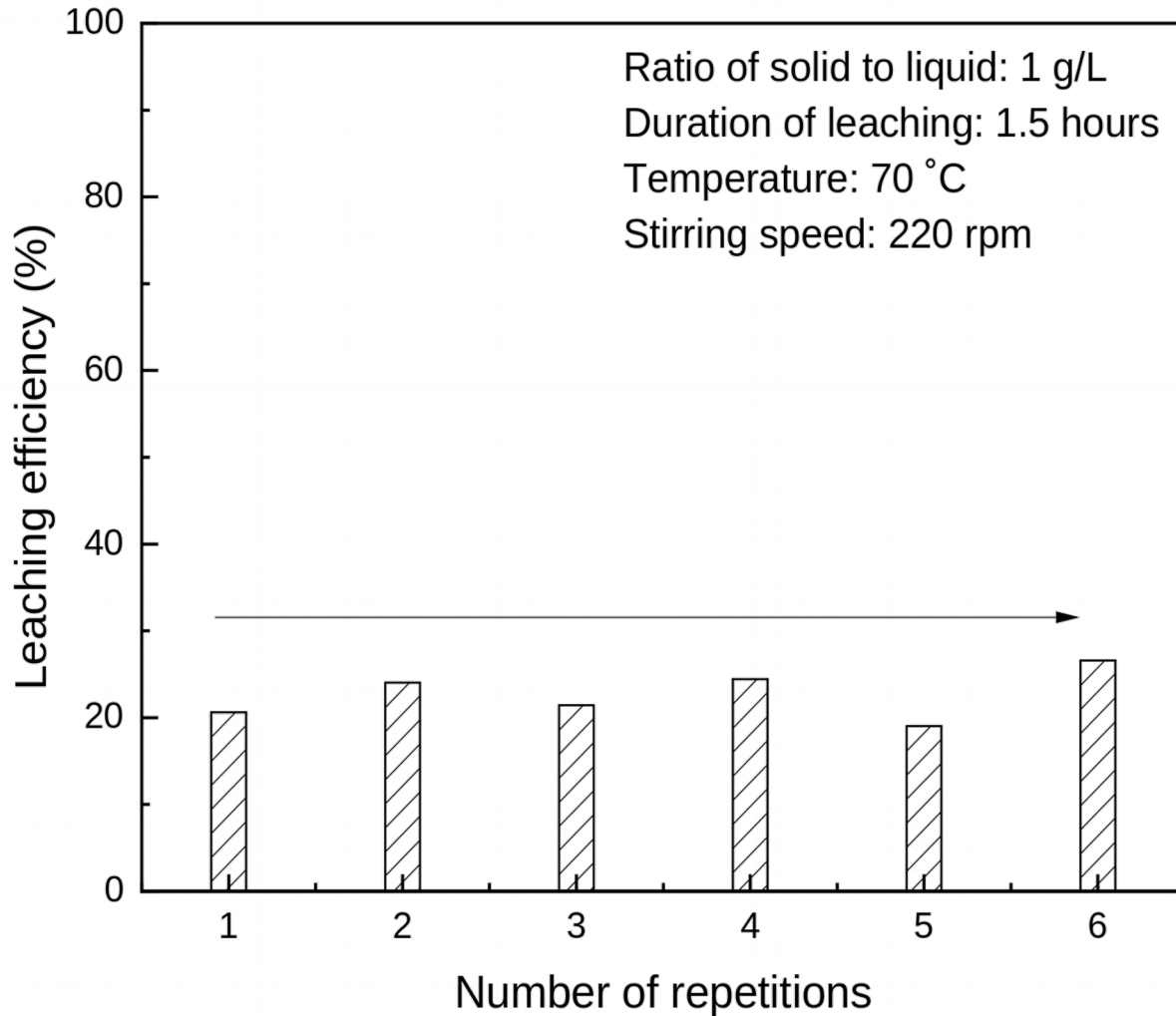


Fig. 7 Six repetitions of the pure AlN leaching

If the content of AlN in black dross is supposed to be around 10%

For the leaching tests, the ratio 1g/L of AlN to liquid can be as a bench mark of the ratio 10g/L of black dross to liquid.

The ratio of black dross to liquid: 10 g/L

The effect of leaching duration:

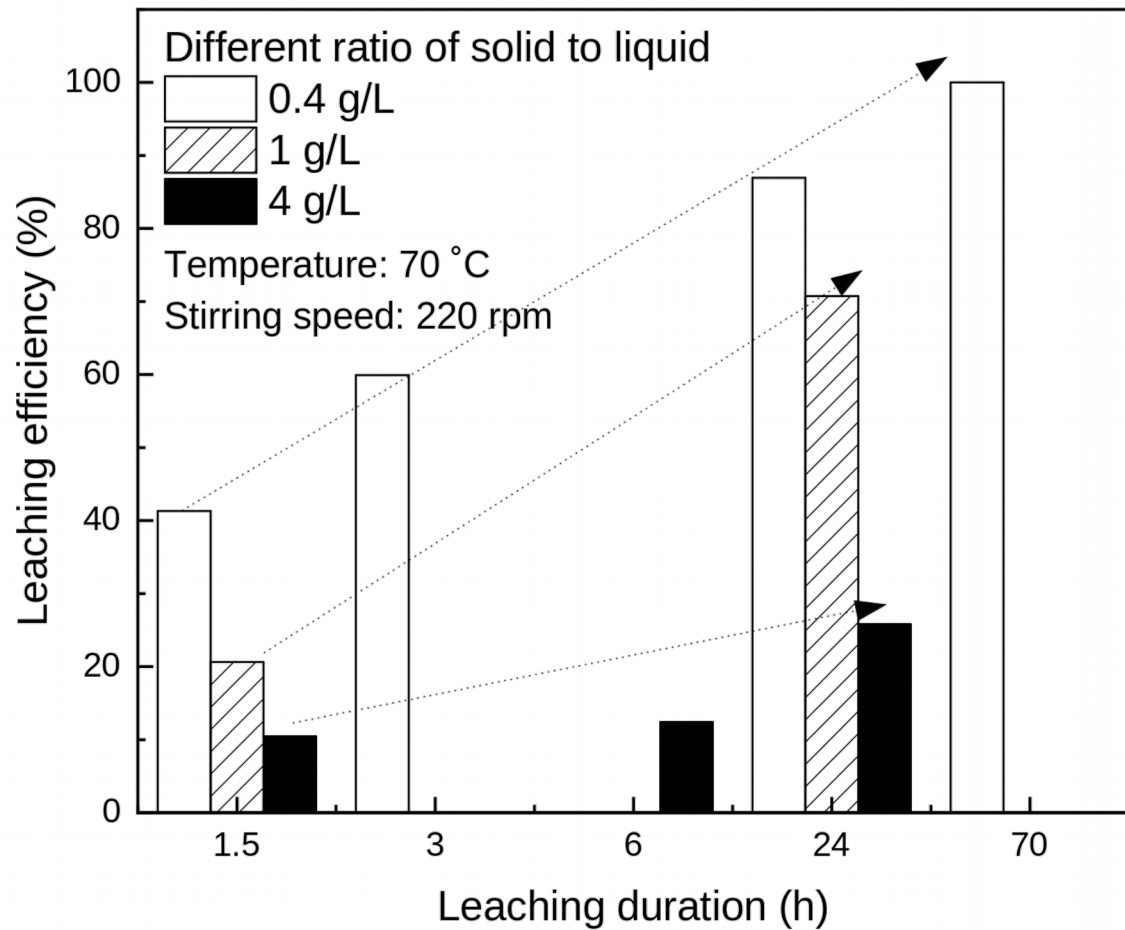


Fig. 8 The effect of leaching duration on the leaching of pure AlN

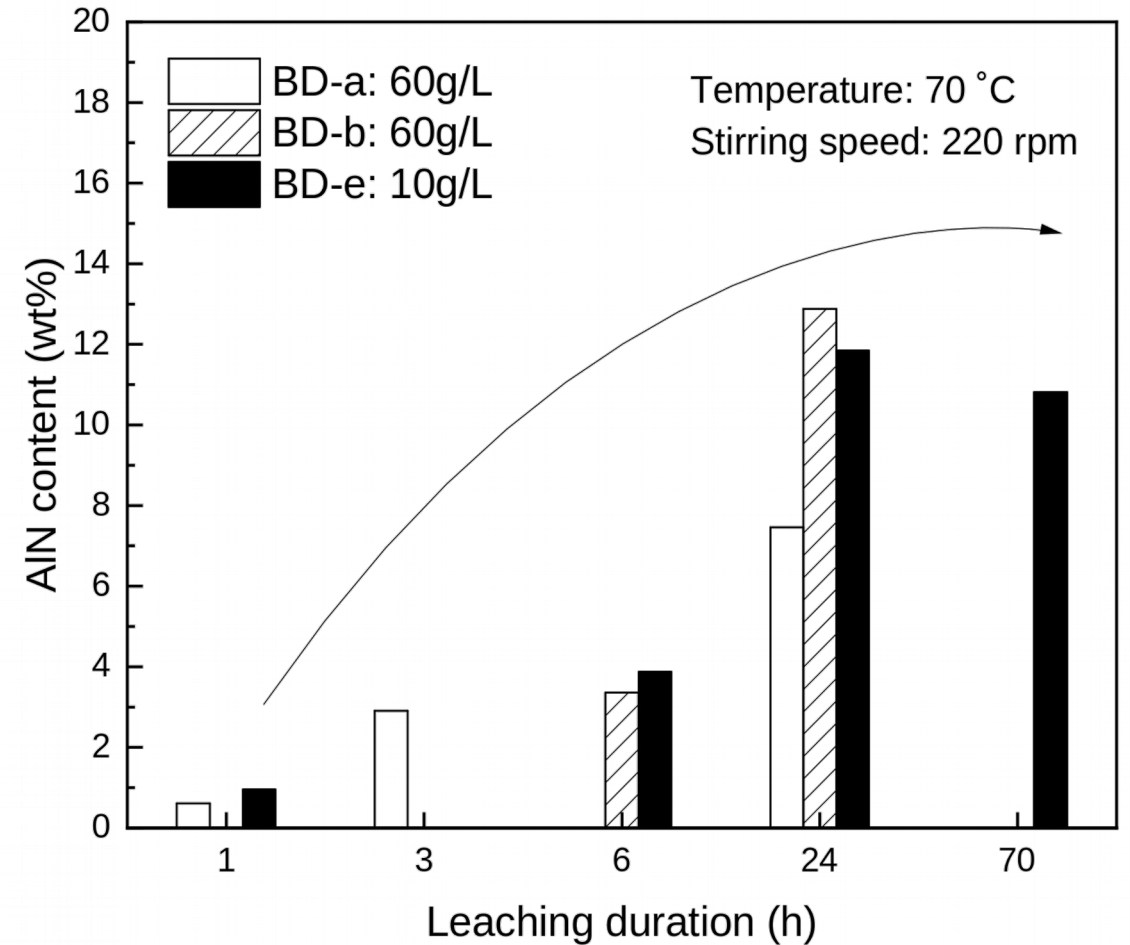
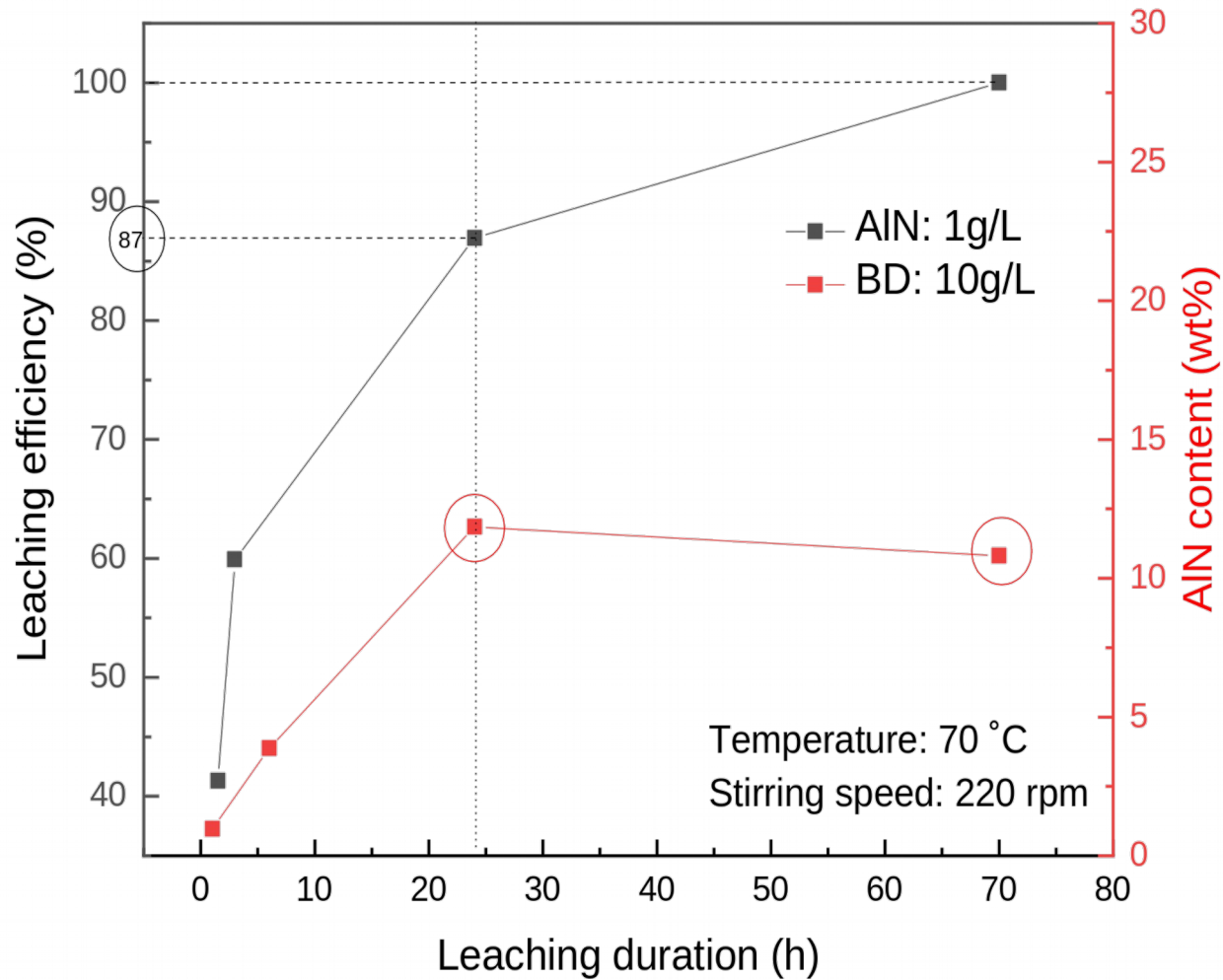


Fig. 9 The effect of leaching duration on the leaching of black dress



Leaching duration:
24 hours

Fig. 10 The comparison of the effect of leaching duration on the leaching of pure AIN and black cross

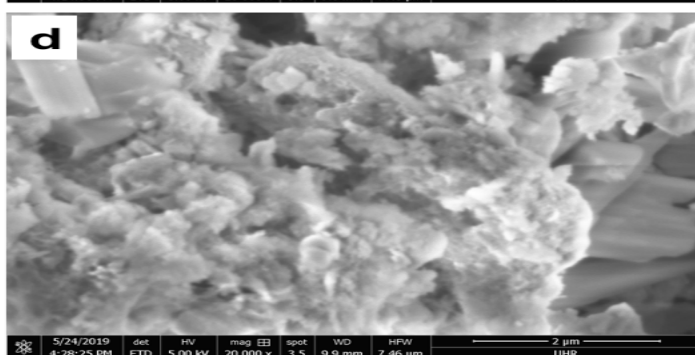
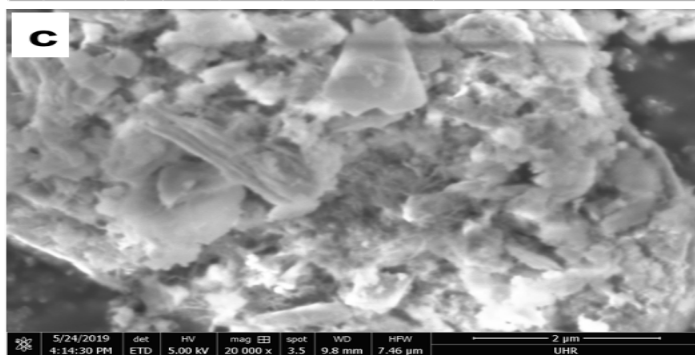
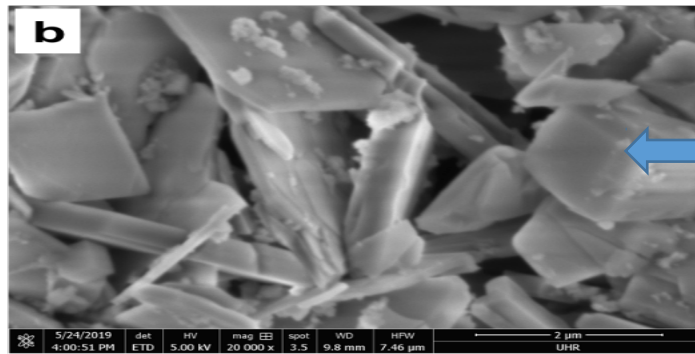
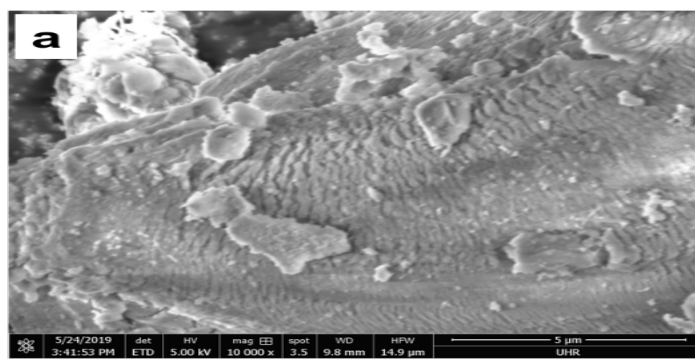
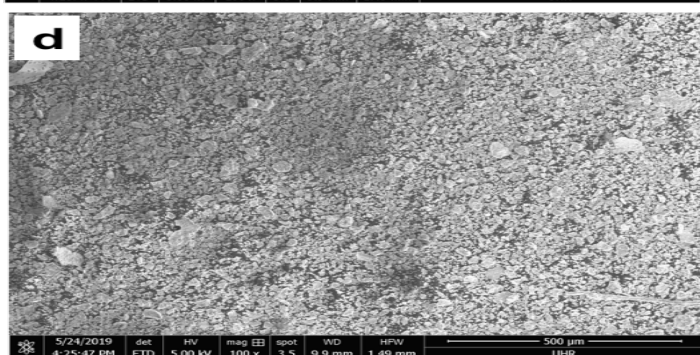
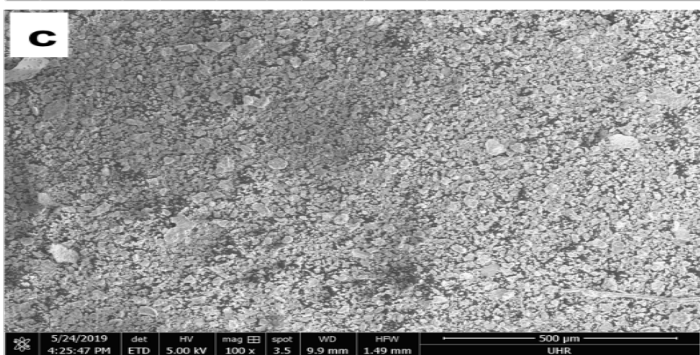
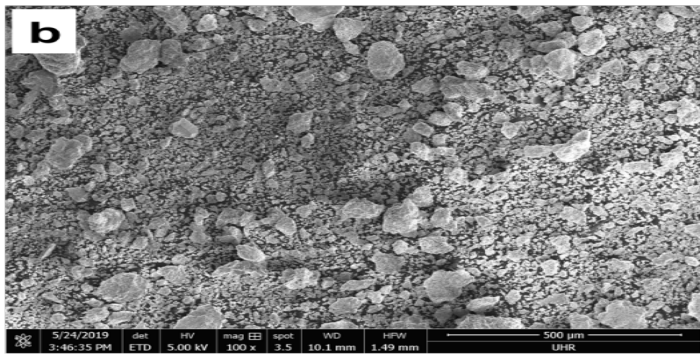
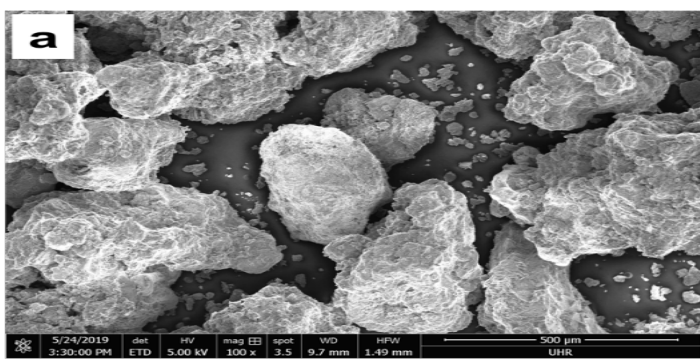


Fig. 12 SEM images of black dross before leaching (a) and leaching residue after 6 hours (b), 24 hours (c), 70 hours (d)

Intermediate product layer - Sodium Aluminium Silicate Hydrate, forming on the surface

Conclusion

- Using alkali-leaching and auto-titration to calculate the content of nitride is a feasible and accurate way to determine the content of nitride in black dross.
- The optimum leaching conditions for leaching were as follows - Leaching Temperature: 70 °C, Stirring Speed: 220 rpm, Ratio of solid to liquid: 10 g/L, Leaching Duration: 24 hours.
- Two gas collectors could effectively absorb the ammonia gas, and the first collector can collect over 85% gas.
- The intermediate product layer – Sodium Aluminium Silicate Hydrate, slowed down the reaction.



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Thank you for your attention!

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