

# Hydrothermal carbonization of black liquor of papermaking into activated carbon and its adsorption of Cr (VI)

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## INTRODUCTION

Black liquor of papermaking mainly contains lignin and its discharge will cause environmental pollution. A self-designed microwave (MW) heating batch type autoclave reactor was adopted to enhance the carbonization of black liquid. The carbon materials exhibited rough surface topology high porosity and were used to treat highly toxic Cr (VI) aqueous solutions with adsorption (Wang et al., 2014).

## MATERIALS AND METHODS

### MW-enhanced hydrothermal carbonization

With hydrothermal carbonization under microwave intensification, the alkali-lignin of black liquor was recycled into activated carbon at the temperature of 200-240°C. The solid activated carbon product was separated by filtration and it was dried for the adsorption of Cr (VI).

### The adsorption of Cr (VI)

50ml Cr (VI) solution and 5g solid activated carbon product were used and the solid activated carbon was separated by filtering.

## RESULTS AND DISCUSSION

### Activated carbon product

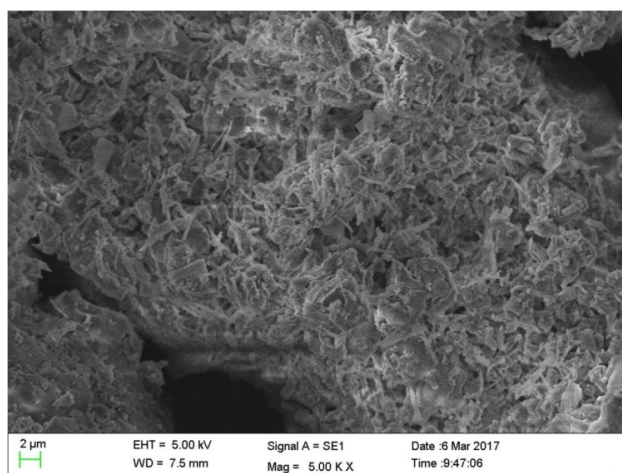
The yield is shown in Table 1 at different reaction temperature and time. The yield of activated carbon increased with increasing temperature and time.

Table 1. The yield of activated carbon at different reaction temperature and time.

Time	1h	2h	3h
200°C	38.54%	43.34%	55.45%
220°C	44.38%	52.48%	58.54%
240°C	47.68%	54.92%	61.60%

### Adsorption of Cr (VI)

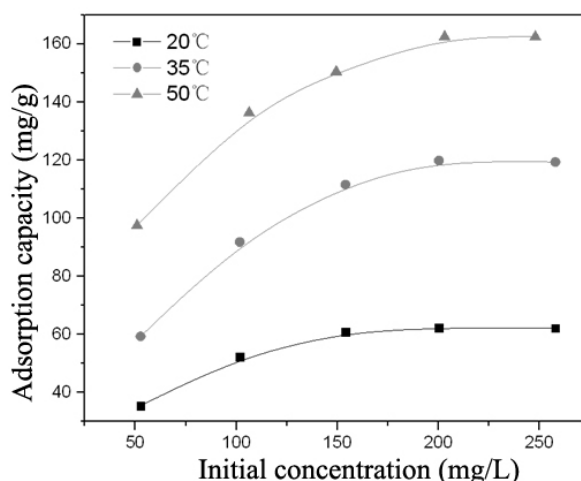
Figure 1 gives the SEM image of the activated carbon after adsorption of Cr (VI), which shows the porous surface of the activated carbon are covered with a dense layer of film-like materials.



**Figure 1. The SEM image of the activated carbon after adsorption of Cr(VI) at 35 °C, initial concentration 150mg/L and pH=2.**

### Initial Cr (VI) concentration

The change of the adsorption capacity of chromium adsorption was demonstrated in Figure 2. The adsorption capacity achieved 166.94 mg/g whereas previously reported adsorption capacity was lower than 60 mg/g.



**Figure 2 The influence of initial Cr (VI) concentration on the Cr (VI) adsorption (pH=2 and Time=240min).**

### CONCLUSION

The activated carbon had very high adsorption capacity of Cr (VI). The adsorption process is mainly by monolayer and chemical adsorption. It is also demonstrated that the Langmuir model is more appropriate for the adsorption isotherm than Freundlich model.

### ACKNOWLEDGEMENT

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### REFERENCES

Wang H., Liu Y., et al., Grafting of  $\beta$ -cyclodextrin to magnetic graphene oxide via ethylenediamine and application for Cr (VI) removal, Carbohydrate Polymers,113: 166-173, 2014.