

## Research Progress of Modified Furan Resins

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**Abstract:** Modified furan resin is a green binder which could widely applied in foundry field. This resin contains furan ring, could replace non-renewable petrochemicals. So modified furan resin has potential to reduce the usage of fossil materials. It is an alternative product of traditional furan resins, exhibits great development potential and socio-economic value. In this paper, we will introduce our recent progress in the synthesis of furan resin by using modified compounds, such as 5-hydroxymethylfurfural. We will also share the achievement of some production process for this resin.

**Keywords:** modified furan resin; process condensation;

### 1 Introduction

Traditional molding binding agent of furan resin is made from petroleum-based furfuryl alcohol, formaldehyde, urea and benzaldehyde. Formaldehyde and phenol are non-renewable petrochemicals; Modified polymer materials are the new polymer materials made from natural renewable resources, such as protein, starch, cellulose, vegetable oil, etc. They are green and renewable materials. The modified furan resin is green and environment-friendly materials with excellent performance. It has better biodegradability, and could avoid secondary pollution. There is basically no harm to the environment in the total life cycle that contains raw materials, production, use and final abandonment. Biomass materials have the advantage of abundant functional groups, wide sources and low price. This paper will mainly introduce the research progress and existing problems in production of modified furan resins from 5-hydroxymethylfurfural.



Biomass raw material 5-hydroxymethylfurfural derivative Bio-based furan resin

Figure 1 Preparation of modified furan resin.

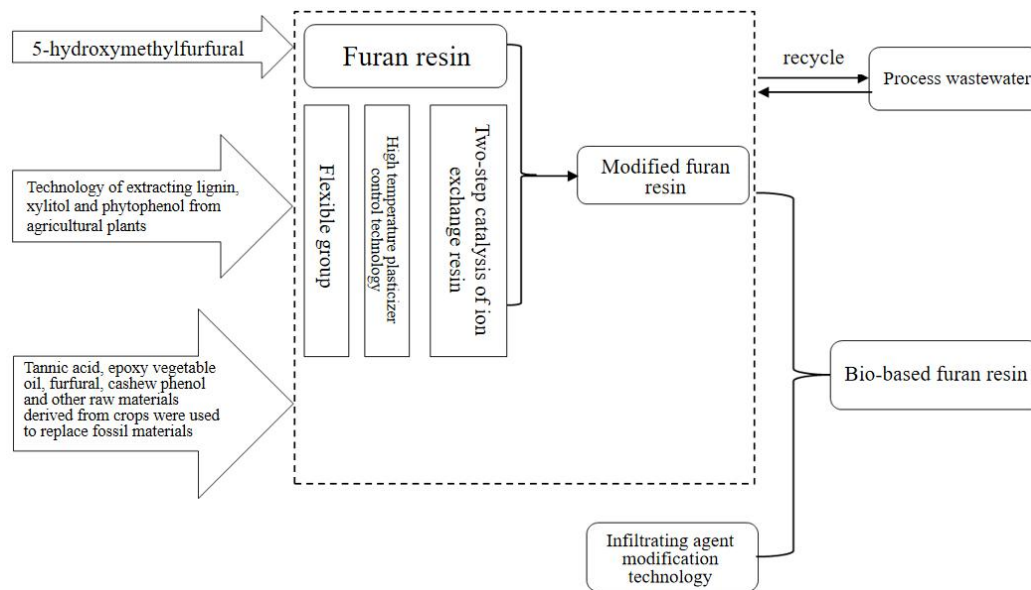
### 2 Result and discussion

#### Preparation of modified furan resin

Our company will share various modification technologies based on furan resin used in the casting, and study the mechanism for producing derivatives of 5-hydroxymethylfurfural. We also optimize the ingredients of modified furan resin, increase the proportion of modified compounds (5-hydroxymethylfurfural, lignin, xylitol, phytophenols, etc.) in resin, which could improve the performance of furan resin in a wide temperature range. The Figure 2 shows the production process of modified furan resin. The performance of modified furan resin prepared by the above process is shown in Table 1.

Table 1. Performance of modified furan resin.

Entry	Index	Performance Data	Modified furan resin	
			Alloy steel molding	Alloy iron moldin g
1.	Environmental performance	VOC, g/L, ≤	50	50
2.		Char Yield, ≥%	56	56
3.		Free Phenol, ≤%	0.1	0.1
4.		Free Formaldehyde,	≤0.1%	≤0.1%
5.		Nitrogen content,	≤0.3%	<2~5%
6.	Room-Temperature Performance	Viscosity, mPa.s, 20℃	50	60
7.		Room-Temperature tensile strength after 24h,	2.5≥Mpa	2.8≥Mpa
8.		The temperature of 5% weight loss℃,	≥260	≥280



**Figure 2. Process chart of modified furan resin system.**

Various bio-acids are employed in the production process of modified furan resin. Some natural acids could act as active monomers and catalysts. Moreover, some flexible organic groups and infiltrating agent are added in the polymers which could improve the performance of resin. As exhibited in Table 2, the modified furan resin has higher performance compared with conventional one.

**Table 2. Comparison of modified and conventional resin**

Entry	Index	Performance Data	Type of Resin	
			Conventional	Modified
1	Environmental Performance	VOC, g/L, ≤	300	50
2		Char Yield, ≥%	50	60
3		Free Phenol, <	<0.3%	/
4		Free formaldehyde, <	<0.3%	<0.01%
5	Room-Temperature Performance	Room-Temperature Tensile Strength After 24h,	≥1.8Mpa	≥2.8Mpa
6	High-Temperature Performance	Load Thermal Deformation, 500°C/60s, Mm	≤2.5	≤1.0
7		Thermal Deformation Duration, S	100~110	90~100

### 3 Conclusion

Biomass material is made from sustainable and abundant resources, which has the advantage of low price and bio-

degradation. It could produce modified furan resin, then replace petroleum, coal and other fossil resources. It shows us an effective way to solve the current resource crisis and protect the environment. Benefited from its green and environmental resource, modified furan resin can partially, even completely replace petroleum-based furan resin. Thus, it has become a rapidly growing emerging industry, and widely applied in sand casting production. While modified furan resin is a new material, its structure, preparation process and application method are not completely understood. Therefore, it is urgent to increase the proportion of biomass materials in the modified furan resin, develop high-performance and low-cost furan resin. We share some production process for the novel biomass materials, and we find such new materials could exhibit outstanding performance as casting binder.

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