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The effect of aqueous MgCl2 pretreatment on the thermal decomposition of Pubescen

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PURPOSE OF THE ABSTRACT

The effect of aqueous MgCl2 pretreatment on the thermal decomposition of Pubescen
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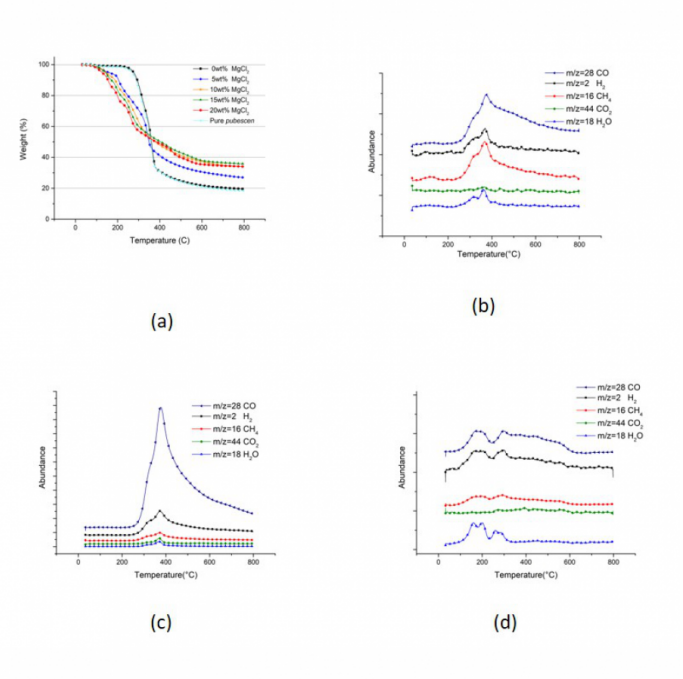
Abstract: The growing concern on global environmental problems have arisen great interest in finding clean and sustainable sources of energy. Renewable resources derived from biomass, which are able to lower the CO2 emission and reduce human's dependence on fossil fuels, have been regarded as promising alternatives. Pretreatment has been widely accepted as one of the most promising way to improve the effective conversion of lignocellulosic biomass.

In this paper, pubescen samples (mainly composed of cellulose, hemicellulose, lignin) obtained from Anji county of Zhejiang province in China were pretreated by aqueous solution of MgCl2·6H2O with different concentrations. The pure and the pretreated samples were characterized by thermogravimetry-mass spectrometry (TG-MS).Table 1 implies that with the increase of the concentration of Mg, the content of Mg in solid residue shows linear growth. The ratios of Mg remained in solid residues over total Mg used in pretreatment are around 13%.

Figure 1a shows the thermogravimetric (TG) curves of the pretreated pubescen samples. As the concentration of Mg in the impregnation solution increases, there is a decrease in initial degradation temperature of pubescen. Furthermore, combining with Table 1, higher concentration of MgCl2 solution could lead to a higher amount of residual solid, which may be due to the increase of mass of residual MgCl2 or the less complete degradation of the samples.

The emissions of small molecular gaseous products in TG are shown in Figure 1b, 1c, 1d.The pure pubescen (Figure 1b) and the water-impregnated sample (Figure 1c) show similar gas generation trends in TG process, in which a lot of small molecular gases are generated between 300 and 450°C, and each of them has only one main peak. According to Andreae MO et al. [1], H2O (m/z=18), CO2 (m/z=44) and CO (m/z=28), are the common gases produced from degradation of the three main components. According to Lv et al. [2], CH4 (m/z=16), is associated to the degradation of lignin. When the samples were pretreated by MgCl2 solution (Figure 1d, 15wt% MgCl2solution impregnated sample as an example), the degradations begin at much lower temperatures, which match the TG curves above. Compared to the degradation of the pure pubescen and the water-impregnated sample, the samples pretreated by MgCl2 solution showed different degradation processes with different compositions of products. These results show the significant effect of aqueous MgCl2 pretreatment on the structure of pubescen samples as well as the catalytic effect of residual MgCl2 on the thermal decomposition mechanism of pretreated pubescen.

FIGURES



Samples	Mg in solid	Ratio of Mg	Solid residue by TG
Pure pubescen	0.1wt%	/	18.4%
0wt% $MgCl_2$	0.2wt%	/	19.6%
5wt% $MgCl_2$	1.5wt%	13.5%	27.0%
10wt% $MgCl_2$	3.0wt%	13.8%	34.0%
15wt% $MgCl_2$	4.3wt%	13.2%	35.9%
20wt% $MgCl_2$	5.8wt%	13.4%	34.0%

FIGURE 1

Figure 1

Fig. 1 a, TG curves for the samples; b, MS curves for pure pubescen; c, MS curves of the samples pretreated by distilled water; d, MS curves of the samples pretreated by 15wt% MgCl2 solution.

FIGURE 2

Table 1

The proportions of Mg in solid residues, the ratios of Mg remained in solid residues over total Mg in pretreatment and the solid residue rates by TG analysis

KEYWORDS

pretreatment | MgCl2 | pubescen | pyrolysis

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