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# Solvent and recovery process for lignin

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## (12) United States Patent

## Thies et al.

## (54) SOLVENT AND RECOVERY PROCESS FOR

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- (51) Int. Cl. *C07G 1/00* (2011.01) *B01D 11/00* (2006.01)
- (58) Field of Classification Search
  CPC . C07G 1/00; B01D 11/00; C08H 6/00; C08H 8/00; C08L 97/005
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### (56) References Cited

### U.S. PATENT DOCUMENTS

### OTHER PUBLICATIONS

Kubo, S., Y. Uraki, and Y. Sano. "Preparation of carbon fibers from softwood lignin by atmospheric acetic acid pulping." Carbon 36.7 (1998): 1119-1124.\*

(Continued)

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## (57) ABSTRACT

Methods for obtaining purified lignin and the lignin that can be obtained by the methods are described. Methods include processing pretreated lignocellulosic biomass feedstock to recover the lignin and provide a lignin composition with a very low level of impurities such as metals and ash. In addition, the lignin recovered from the process can have a narrow molecular weight distribution and, depending upon the specific stages utilized in the process, can have a predetermined molecular weight. The process includes one or more separation stages in which a lignin-containing feedstock is mixed with a solvent solution. The mixture fractionates to form a solvent-rich liquid phase and a ligninrich liquid phase, the lignin being partitioned across the phases according to the molecular weight of the lignin. Furthermore, the metal salts of the pretreated lignocellulosic biomass feedstock also partition across the phases.

## 11 Claims, 4 Drawing Sheets

