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アルカリ処理木材の水分吸着特性と細胞構造

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Adsorption Properties and Structural Features of Alkali Treated Wood

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In order to investigate the influence of alkali treatment on structural features and on hygroscopic properties, weight and dimensions were measured after wood samples (*Picea jezoensis* Carr.) were treated with aqueous solutions of various NaOH concentrations and conditioned at various relative humidity conditions.

In the oven-dry condition, volume and cross-sectional area of wood samples treated at NaOH concentrations ranging from 0 to 15% decreased, and at NaOH concentrations ranging from 15 to 20% they remained constant. Longitudinal contraction occurred in wood samples treated at NaOH concentrations ranging from 12 to 15%. These observations were due to both dissolution of wood components and wood structure deformation resulting from transformation of cellulose microfibrils.

The equilibrium moisture content of treated wood samples was larger than untreated wood samples except when the wood samples were treated with aqueous solutions of 5% NaOH concentration and conditioned below 71% RH. The water sorption isotherms of untreated and treated wood samples were analyzed by using the Hailwood & Horrobin equation. The number of sorption sites per 1g of wood sample decreased in the NaOH concentration range of 0 to 5% and increased at the NaOH concentration of 20%. The equilibrium constant of formation of hydrated water increased in the NaOH concentration range above 10%. It was speculated that the hygroscopicity at low relative humidity was reduced due to dissolution of hemicellulose in the NaOH concentration range of 0 to 5% and increased due to increases in the proportion of amorphous components in the NaOH concentration range above 10%. Cluster size increased in the NaOH concentration ranges of 0-5% and 10-12% at high relative humidity. It is suggested that the changes in hygroscopicity at high relative humidity were due to increased void spaces as a result of dissolution of hemicellulose and of intermicellar and intramicellar swelling.

Key words: alkali treatment, contraction, structural features, microfibrils, adsorption properties
アルカリ処理, 収縮, 細胞構造, ミクロフィブリル, 吸着特性

アルカリ処理による木材細胞構造と吸湿特性の変化を検討するため、エゾマツ試験片を用いて、NaOH処理(処理濃度0～20%)し重量、寸法変化の測定と、調湿9条件で吸着試験を行った。絶乾状態において体積と断面積は処理濃度15%まで減少し、15%以上ではほぼ一定となった。繊維方向収縮は12～15%で生じその前後で一定の値を示した。これらは、処理濃度5%までの木材成分の溶脱と、処理濃度12%以上での細胞壁のマイクロフィブリルの収縮による細胞構造の変化に起因すると考えられた。

吸着試験の結果、NaOH処理濃度5%において相対湿度71%以下で未処理材より含水率が減少し、その他の条件では含水率が増加した。Hailwood & Horrobin解析の結果、木材1g当たりの吸着サイト数は、処理濃度5%で減少し20%で増加、水和水の生成に関わる平衡定数は、処理濃度10%以上で増加した。低相対湿度での吸湿性は、処理濃度5%ではヘミセルロースの溶脱により減少し、10%以上ではセルロースの非晶領域の増加に伴い増加することが考えられた。吸着点1つに吸着する水分子の数(クラスターサイズ)は、高相対湿度になるに従い変化が認められ、処理濃度5%で増加した後12%で再び増加した。高相対湿度における吸湿性は、処理濃度5%までの木材成分の溶脱と、処理によるセルロースのミセル間及びミセル内膨潤により生じる木材中の空隙に起因して変化することが考えられた。

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