ABSTRACTS (MASTER THESIS)

Effect of kraft pulping on cellulose nanofibrillation

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Introduction

Cellulose nanofiber (CNF) owns the characteristics of high strength, high Young's modulus, low coefficient of thermal expansion to be applied to various industries, however, the high production cost causes it difficult to be used by the industries. Currently, kraft pulping is the dominant pulping process to produce commercial kraft pulp, which is utilized as a starting material to make CNF in many areas. The mechanism that affects the kraft pulping process on nanofibrillation has remained unclear until today. The present study aims to explore the effects affecting the kraft pulping process on nanofibrillation as a foundation for modifying the low efficiency in CNF production.

Materials and methods

The wood powder of 60-100 mesh from Todomatsu (*Abies sachalinensis*) was used. The kraft pulp sample was prepared by cooking the wood powder with NaOH/Na2S solution (kraft pulping) at 160℃ for 5 hours and further purified with sodium chlorite under acidic condition and potassium hydroxide solution. The non-kraft pulp was prepared the same as the kraft pulp but without the kraft pulping process. Furthermore, non-kraft pulp was treated at 160℃ and 1 hour with water and alkaline respectively. Samples were prepared into 0.7% suspension and treated with a high-speed blender with different time to observe the degree of fibrillation. CNF was prepared from non-kraft pulp after passing two times of stone grinder. 250 mL of 1% CNF was prepared and cooked in the portable reactor at 160℃ for 1 hour to simulate the pulping process.

Results and discussion

Kraft suspension and non-kraft suspension has a different degree of fibrillation shown in Figure 1(a) and 1(b). Also, the non-kraft treated suspension has a higher specific surface area and water retention value comparing with kraft treated suspension. The non-kraft suspension is more easily to fibrillate then the kraft suspension. The non-kraft suspension cooked at 160℃ with water and alkaline solution shown in Figure 1(c) and 1(d) have a different degree of fibrillation with the non-kraft suspension shown in Figure 1(b). The non-kraft pulp treated with 160℃ for 1 hour with water and alkaline in Figure 1(c) and 1(d) showed a similar suspension state with the non-kraft suspension in Figure 1(a). CNF suspension shown in Figure 2 cooked at 160℃ with water and alkaline solution aggregated after cooking. Kraft pulping process will have an unfavorable effect on the nanofibrillation of pulp. The reason for the unfavorable effect may due to microstructural change during the high temperature and high-pressure cooking.

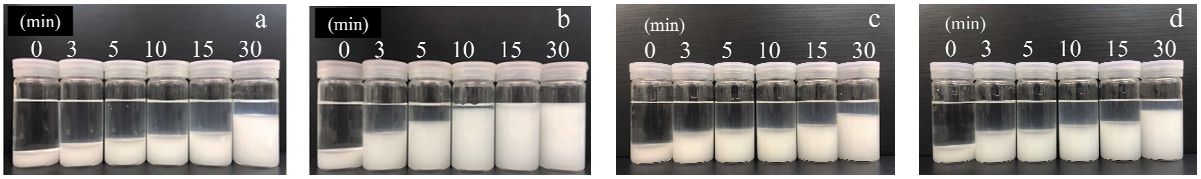

Figure 1. (a) kraft suspension (b) non-kraft suspension (c) non-kraft suspension cooked with H_2O at 160℃ for 1 hour (d) non-kraft suspension cooked with NaOH at 160℃ for 1 hour

Figure 2. CNF suspension cooked at 160℃ for 1 hour with water and alkaline respectively