

INFLUENCE OF CONTACT LOAD ON TRIBOLOGICAL BEHAVIOR OF POLY(VINYL ALCOHOL) HYDROGELS AS ARTIFICIAL CARTILAGE MATERIAL

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KEYWORDS

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ABSTRACT

1. Introduction

Poly(vinyl alcohol)(PVA) freezing-thawing (FT) gel, cast-drying (CD) gel, lamination-type hybrid gel composed of FT and CD gels (Hyb-LM), and composite-type hybrid gel as composite cross-linking networks of FT and CD gels in single layer (Hyb-CP) were developed as artificial cartilage material. Hyb-CP showed low friction and wear^{1,2)} and its friction coefficient has no sliding-speed dependency³⁾. In daily activities, not only sliding speed of articular joint surface but also applied load varies, so artificial cartilage materials have to show excellent tribological properties under varying sliding conditions. In this study, the influence of contact load on friction property of PVA hydrogels was evaluated.

2. Methods

15 wt% solution of PVA (average polymerization degree: 1,700, saponification degree: 98.0~99.0 mol%) was used as raw material for PVA hydrogels. FT gel was prepared by repeated freezing-thawing method with the same condition in previous study¹⁾. CD gel was prepared by cast-drying method with drying temperature of 60°C and humidity of 80%RH (CD-HT) or 8°C and 50 %RH (CD-LT). For the preparation of Hyb-CP gel, FT gel was firstly prepared in polystyrene dish by single FT treatment. Then, the sample was dried in the temperature and humidity controlled chamber (60°C, 80%RH). After the drying process, the samples were treated by single FT process. The sample was dried in the temperature and humidity controlled chamber (8°C, 50%RH) and the dried sample was swollen in pure water and Hyb-CP gel was obtained.

The sliding pairs of flat PVA hydrogels and an alumina ceramic ball ($\varphi = 26$ mm) were tested in reciprocating friction test. The applied load was 0.98, 4.9, 9.8, 14.7 and 24.5 N. The sliding speed was 30 mm/s and the total sliding distance was 2.5 m. Pure water was used as a lubricant for friction test. All

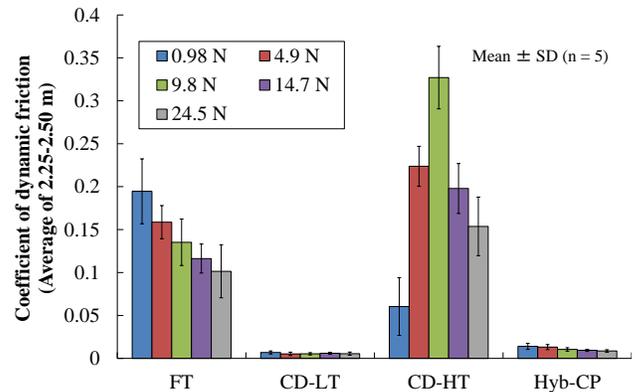


Fig.1 Coefficient of dynamic friction of PVA hydrogels

friction tests were conducted in room temperature.

3. Results and discussion

FT and CD-HT gels showed load-dependency of coefficient of dynamic friction (CoF) and CoF of FT gel decreased with increase of applied load. CoF of Hyb-CP gel slightly decreased with increase of applied load, but CoFs of Hyb-CP and CD-LT gels were nearly constant. In previous studies, CoFs of Hyb-CP and CD-LT gels showed no sliding speed-dependency³⁾ but wear resistance of Hyb-CP gel is superior to CD-LT gel^{1,2)}. These results indicated that Hyb-CP gel has superior tribological property under varying sliding condition expected in articular motion.

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