Biaxially Oriented Shrinkage PA6 Film

M.Takashige[(a)] ,T.Kanai[(b)]
(a) *Idemitsu Unitech Co, Hyogo, Japan*
(b) *Idemitsu Kosan Co, Chiba, Japan*

Abstract

Environmental problems have come into question in the packaging industry. A biaxially oriented PA6 film produced by double bubble tubular film process is fit for shrinkage film. To produce high shrinkage film, the influence of material design and process condition on shrinkage property is investigated. The blend of PA6-66 and MXD6 can achieve as high as polyvinyliden chloride, and further shrinkage film of this blend has easy straight cut property. The material and production technology of a PA6 film could solve high shrinkage, environmental and long life packaging problems.

Introduction

The biaxially oriented film made of polyvinylidene chloride is widely used as a shrinkage film for packaging of ham and sausage etc, because of good shrinkage property and gas barrier performance [1]. When this film is incinerated, it generates toxic gas such as chlorine gas and dioxin. The development of oxygen gas barrier film without halogenated compound is desired. In this point, shrinkage film which can package ingredient tightly and solve environmental problem is required. The packaging of sausage and meat uses rocket package which needs calking of aluminum, but it cannot seal package perfectly. Further as aluminum is used, the metal detector is not used. There is a problem of safety and package opening, and the change of package system is desired. The development of high shrinkage film is desired by using double bubble tubular film process. A film which adapted to environmental problem and shrinkage property is developed in this research.

Experimental

Ube PA 1023FD (PA 6) , Ube PA 6-66 copolymer 3053 (PA 66 content 15%) and Mitsubishi Gas Chemical MX PA 6007 were used. The maximum stress at the end point of stretching was obtained [2]. The heat set temperatures were changed and the shrinkage in hot water as a function of temperature was evaluated. PA 6 and MXD 6 blending polymers were evaluated to promote barrier property, shrinkage and easy straight cut performance. PA 6-66 copolymer was also evaluated in terms of shrinkage.

Results and Discussion

Shrinkage percentage decreases with increasing heat setting temperature (Fig.1). High heat setting temperature makes high crystallization and low shrinkage. Table 1 shows physical properties of biaxially oriented PA 6 for general purpose film and shrinkage film. Shrinkage increases with decreasing heat setting temperature. Low heat setting temperature makes low crystallinity, high tensile strength and high impact strength.

PA 6-66 copolymer has lower stretching stress than PA 6, because hydrogen bond and crystallization of PA 6-66 is due to be suppressed by copolymerization(Fig.2). PA 6-66 has good continuos processability without any break.

Shrinkage linearly increases with increasing in hot water temperature between 50 and 120℃ (Fig.3). PA 6-66 has 10% higher shrinkage at the retort condition than PA 6.

The blend film of PA 6 and MXD 6 was studied with an expectation of shrinkage and easy tear properties [3]. As it is expected, this blend film has easy straight cut property. High performance shrinkage film was developed.

The blending polymers of PA 6 and PA 6-66 keep the compatible performance of high strength and high shrinkage and they could solve environmental and barrier free problems.

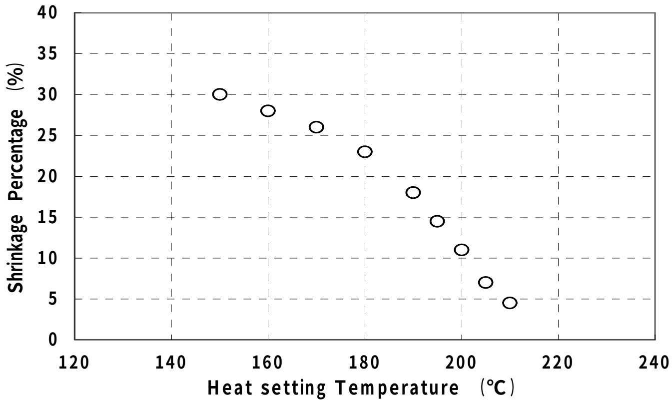

Fig.1 Relationship between heat setting temperature and shrinkage percentage

Table 1 Physical properties of biaxially oriented PA 6

General purpose film v.s. Shrinkage film

Properties	Use		General Purpose Film	Semi Shrinkage Film	Shrinkage Film	Testing Method
	Heat setting condition		210℃	195℃	160℃	
Tensile Strength	MPa	MD TD	260 290	300 320	320 330	ASTM-D882
Film Impact Strength	J/m		93,000	101,000	105,000	IPC Method
Shrinkage Percentage	%	MD TD	4.5 4.5	14.0 13.5	28.0 28.0	120℃ - 30min

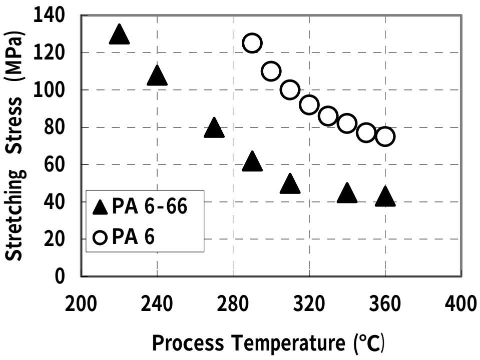

Fig. 2 Relationship between process temperature and stretching stress

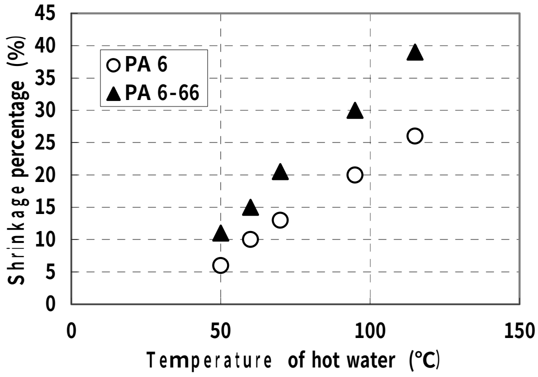

Fig. 3 Relationship between temperature of hot water and shrinkage percentage

References

1. U.S.Patent 2,409,521 (1946), Wiley,R.M.,
2. Takashige,M., Kanai,T : Int. Polym. Process. 5, p.287 (1990)
3. Takashige,M., Kanai,T., Yamada,T. : Int.Polym.Process.19, p.147 (2004)