Abstract:

JFE S ee ha de e ed a d c e cia i ed a e PET-a i a ed i f ee ee (TFS) hee f f d ca , UNIVERSAL BRITE T e F, hich a i ed he e -f a ce e i e e f f d ca a d i a e i- e -f ie d . A fea e , UNIVERSAL BRITE T e F ha a exce e ba a ce f high f abi i a d he c e e ea e , hich i e i ed i f d ca i g a ica i . A exce e c e e ea e - e a ea i ed b addi g igi a face- dif i g addi i e he e h e e e e h ha a e (PET) ed ce he face f ee e e g f he PET . F -abi i i a ed i ed b a i g a c bi a i f a e h e PET (h -PET) i h a i e c e a d a igi a a i a i g ech g hich i hibi PET c a i a i .

1. Introduction

From the viewpoint of protecting the global environment and improving the labor environment during painting work, in recent years, the can-making industry has avoided the use of organic solvents in painting, either by converting to water soluble lacquer or adopting thermoplastic resin laminated films as an substitute for paint. Against this background, cans produced from steel sheets laminated with a polyethylene terephthalate (PET) film have already been commercialized in the field of beverage cans1). As advantages of film-laminated steel sheets, because the painting/baking process required with conventional painted materials can be omitted, (1) costs are reduced by eliminating this out breaking or cracking. Although it is possible to produce draw-redraw (DRD) food cans using copolymer PET-laminated steel sheets[2], the high cost of the film (due to the high cost of the copolymer component) was a problem. Application of inexpensive homopolymer PET (homo-PET) film-laminated steel sheets is desirable as a solution to this problem, but because homo-PET films have an remarkably high crystallization kinetic in comparison with copolymer PET films[3], rapid crystal growth occurs during can-making due to the stress and heat generated by the bending and drawing processes. As a result, this material is unable to follow forming and could not be applied in can-making. JFE Steel therefore carried out an investigation focusing on techniques for inhibiting crystallization of the PET film, and studied application of a new type of homo-PET film[4] in which crystallization behavior is inhibited by reducing the mobility of the PET molecules. As a distinctive feature of this technique, the molecular structure of the PET is controlled so that some amorphous molecules form a quasi-bridge structure, thereby reducing their mobility.

(3) In the external appearance of food cans, a color tone (metallic color, etc.) with a rich luster is required. For this reason, it is necessary to impart an appearance with a metallic color to laminated steel sheets for food cans by adding a colorant to the film. However, if heat treatment such as retort sterilization (125°C, 90 min) of the contents is performed, the colorant tends to lose its color due to migration/segregation to the film surface, deteriorating the design property. Therefore, a technique for inhibiting this phenomenon of heat-induced migration of the colorant was studied.

3. Experimental Method

3.1 Specimens

The substrate used for film lamination was a tin free steel (TFS) of low carbon aluminum-killed continuous slab-cast steel (Temper degree: T3CA, Thickness: 0.24 mm) with a metallic chrome coating weight of 120 mg/m^2 and chrome hydrate oxide coating weight of 15 mg/m^2 (as Cr content). Surface free energy was adjusted by laminating a new type of biaxially-oriented homo-PET film (Thickness: 15 μm), to which various types of surface-modifying additives had been added, to the surface of mofas t ho03 T (nat 88 (TFS) appearaT*0.2is control)1mo-20.sho was used as the BO value. Here, X-ray diffraction measurements were performed by Cu Kα at a tube voltage of 40 kV and current of 100 mA, using a RINT2400V device manufactured by Rigaku Corp. In this paper, a value BO/BO$_0$, which was obtained by standardizing the BO value after lamination by the BO value before lamination (BO$_0$), was used as biaxial orientation.

4. Experimental Results

4.1 Results of Study of Content Release Property

The results of an investigation of the effect of surface free energy on the content release property are shown in **Fig. 2**. A clear relationship can be observed, in which the content release property improves as surface free energy decreases.

The surface free energy of the specimens was adjusted by adding surface-modifying additives to the PET film. Therefore, the effect of each of the surface-modifying additives was investigated. **Table 2** shows the surface-modifying additives used here. Additive A is silicone and is non-polar. Additive B is a fatty acid ester which has polarity in the carbonyl part, as well as a non-polar part in the hydrocarbon chain. Additive C is a vegetable wax. Like Additive B, it consists mainly of a fatty acid ester, but due to the large carbon number of the hydrocarbon chain, the non-polar part forms the main structure of Additive C.

The effects of these surface-modifying additives are shown in **Fig. 3**. From these results, it can be understood