Universal Bright – a New Film Laminated Tin-free Steel Sheet for Food Cans

1. Introduction

Recently, the can manufacturing industry is increasingly using water-soluble lacquers or thermoplastic resin laminates instead of paints containing organic solvents. This is for the following reasons: global environmental conservation, environmental problems at work places associated with painting work, and health and safety of consumers. Traditionally, the food can manufacturing industry has been using lacquer coated steel sheets. However, there is a move to regulate the use of lacquer coated steel sheets in the EU due to the discovery that bisphenol contained in the lacquer paint is an endocrine disrupter. Under these circumstances it was desirable to develop new types of laminated steel sheet. These new laminated steel sheets would not contain endocrine disrupters, but would have properties comparable to, or better than conventional lacquer coated steel sheets, and would be easy to form, enable laminated film to firmly adhere to the substrate steel sheet, be corrosion resistant, and easily release their contents. The new product also had to be compatible with existing can manufacturing facilities[1)].

NKK responded to such requirements and developed and marketed a world-first film laminated steel sheet for food cans that satisfied the requirements as can-making steel sheets, including the content release property. This new material is also manufactured at a lower cost. **Fig.1** shows the development concept.

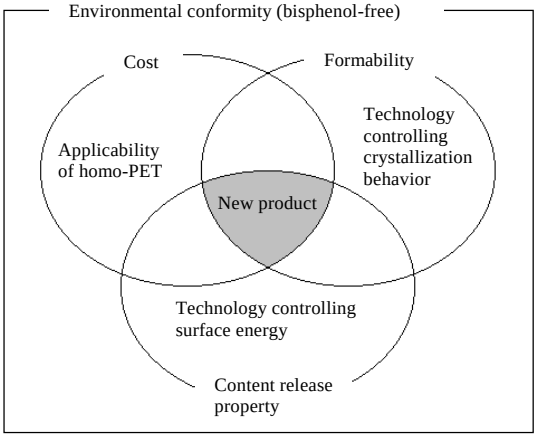


Fig.1 Development concept

2. Overview of the new film laminated steel sheet for food cans

Fig.2 shows the structure of the new film laminated steel sheet for food cans. The substrate for film lamination is a TFS (Tin-free Steel), or a cold-rolled steel sheet on which metallic chromium and hydrated chromium oxide are electrolytically precipitated. Two layers of newly developed PET films are heat-laminated onto the substrate.

For economic reasons, an inexpensive homo-PET film is used as the underlying film in the two-layer film structure. However, ordinary homo-PET has very high crystallization kinetics, crystallizing about 10 times as fast as co-PET. Therefore, ordinary homo-PET cannot be applied to the can-making process, because rapid crystallization occurs during the forming process, and formability is impaired.

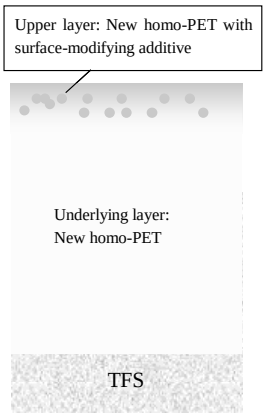


Fig.2 Cross-section of the new laminated steel sheet for food cans

NKK therefore adopted a homo-PET of special molecular design as the underlying film in order to modulate the crystallization kinetics. This film was experimentally applied to a TFS, and its formability was investigated. The result is shown in **Fig.3**. The formability of the new film laminated TFS was markedly improved by adjusting the orientation of the film after lamination. Formability is sufficiently high for this steel sheet to be processed into food cans by DRD (Draw-Redraw) forming. It is possible to improve formability further by optimizing the film structure after lamination.

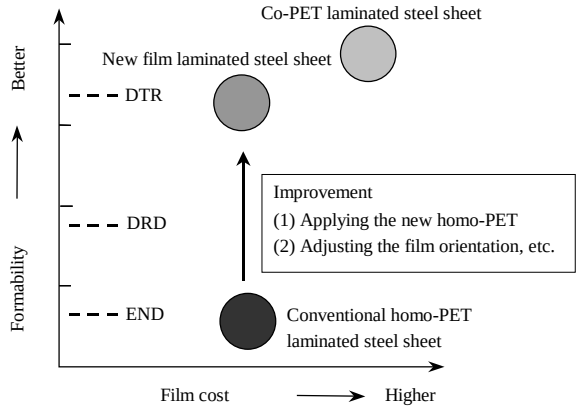


Fig.3 Formability of new film laminated steel sheet

The new modified homo-PET film was applied as the upper layer of the two-layer films in order to improve the content release property. The content release property is correlated to the surface energy at the interface between the content and the can material. As surface energy level lowers, content release property improves. Content release properties were evaluated for various steel sheets with different surface energy. The results are shown in **Fig.4** and **Table 1**.

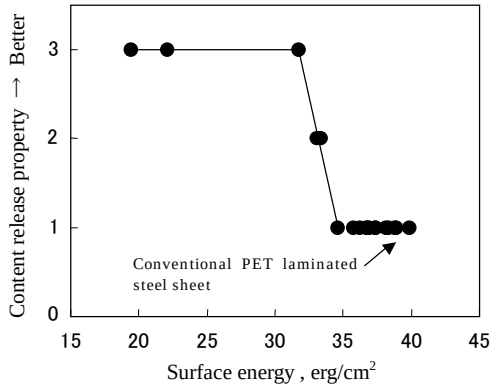


Fig.4 Effects of surface energy on content release property

As shown in **Fig.4,** the conventional PET laminated steel sheet has a high surface energy resulting in a poor content release property.

NKK studied the effect of adding surface-modifying additives to the PET film to lower the surface energy. **Fig.5** shows the results. The effect varies with the type of surface-modifying additive. Additive "C" proved to be the most effective. The content release property was thus improved by adding an appropriate amount of additive C to the homo-PET. The surface-modifying additive is added to the upper layer only so that the additive may not affect the film's adherence to the substrate TFS, and also to minimize manufacturing costs.

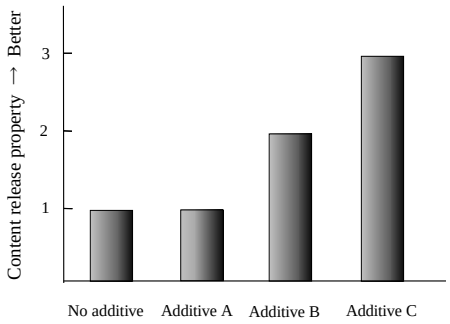
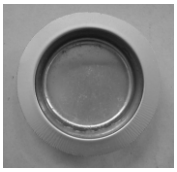
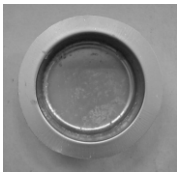
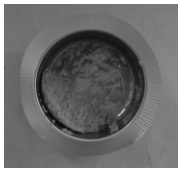
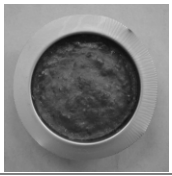


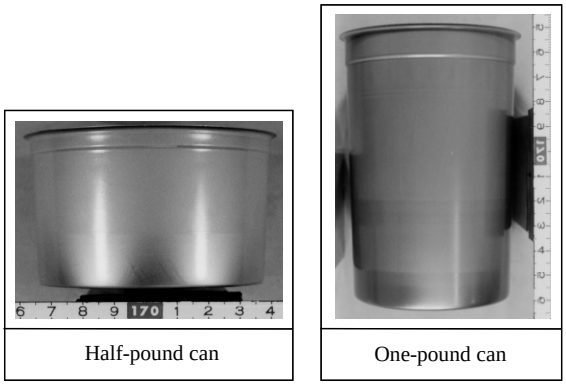
Fig.5 Effects of various surface-modifying additives on the content release property

3. Food cans made from the new film laminated TFS

Photo 1 shows food cans made from NKK's new film laminated TFS. Two types of cans are shown; a half-pound can and one-pound can. No wall breaking, cracks, or wrinkles were generated in the forming process. Excellent formability was confirmed. It also maintained a high quality level over a long period after the cans were filled with the contents.

Table 1 Evaluation method for content release property

Score	3	2	1	Before taking contents out
Content release property	The contents are easily taken out with hardly any content left sticking to the cup	The contents are rather difficult to take out with part of the contents left sticking to the cup	The contents are difficult to take out with much of the contents left sticking to the cup	(1) Contents: Mixture of meat, egg, and oatmeal. (2) Retort condition: 121℃×90 min
Appearance after the contents were taken out				



Half-pound can | One-pound can

Photo 1 Cans made from the new film laminated TFS

4. Conclusion

NKK has successfully developed and marketed a new film laminated TFS, Universal Bright that does not contain an endocrine disrupter, and excels in content release property and formability. Universal Bright is now being manufactured on a large scale for export to North America and other overseas markets. Universal Bright is expected to become a next-generation standard product for making food cans and its sales will expand rapidly.

Reference

1) Maruki, S. Syokuryo-to-Youki. Vol.40, No.12, pp.672-675(1999).

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