Effect of elongational viscosity on interfacial instability on polyethylene coextrusion flow

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Abstract

Multilayer film technology has been used in various industrial fields, for example, food packagings, flexible displays, and optical films. This technology can provide the film high functionalities such as gas barrier, mechanical property, and so on. Although there are several layering methodologies of the polymeric films, in particular, coextrusion has the important advantage that two or more polymers can be laminated on the thin polymeric substrate at one step with low cost. It has been, however, known that this method often gives rise to a occurrence of the interfacial roughness between polymer melts, leading to serious problems in the appearance and physical properties. It has been reported that the interfacial instability occurs for confluent flow of the same material of divided flow of LDPE melts.

In this study, we examined the confluent flow behavior of identical materials for polyethylenes with different chain architectures by using two extruders. We determined coextrusion conditions by 2D pure viscosity simulation. Figure 1 shows the appearance of extruded films of same PE pairs of LDPE and HDPE. The interfacial roughness occurred for LDPE/LDPE (see Fig1c), while HDPE/ HDPE showed the smooth interface (see Fig.1d) in spite of the same interfacial stress as that of LDPE/LDPE. Further, LLDPE/LLDPE also showed the same tendency as that of HDPE/HDPE. One possibility of the difference of the unstable flow between LDPE and HDPE is the elongational behavior, resulting from their chain architectures (see Fig.2). In this study, we will discuss the effect of the rheological properties associated with the chain architecture of PE on the interfacial instability.

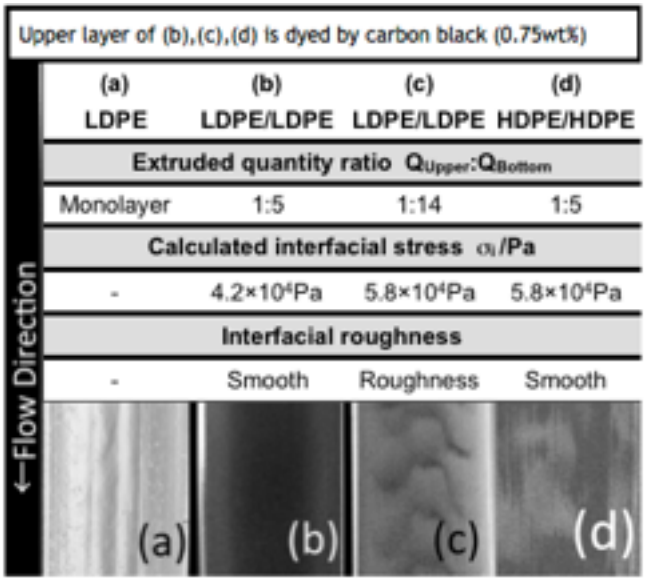

Figure 1 Coextrusion film appearance

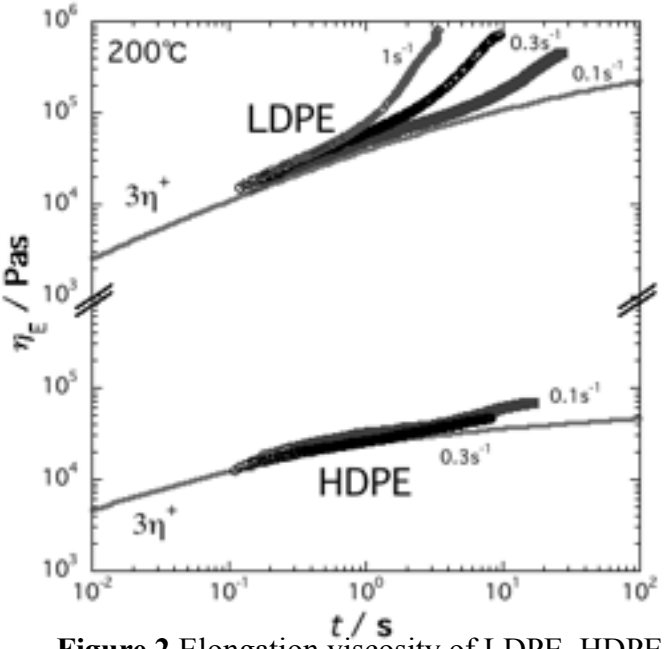

Figure 2 Elongation viscosity of LDPE, HDPE

Keywords :" LDPE", "LLDPE", "Interfacial instability", "Coextrusion"