Abstract

One of the most common greenhouse covering materials in Saudi Arabia is polyethylene film. However, polyethylene films are susceptible to mechanical failure due to harsh conditions of high temperature, solar radiation, and wind as occurs in Riyadh, Saudi Arabia. This study examined effects of ambient conditions on the deterioration of mechanical properties of polyethylene films over 14 months, using an experimentally cooled empty greenhouse (3.6 m length, 2.4 m width, and 3.6 m height) covered with a single layer of 200-μm thick polyethylene. Three mechanical tests were conducted on the polyethylene samples: penetration, shear, and tension utilizing a SMS texture analyzer. The force–distance curves produced were characterized by two stages, the elastic and plastic regions. Mechanical properties were determined, including modulus of elasticity, rupture point, and total work for each stage of the three tests. Generally, mechanical resistance of the samples decreased with increased exposure time. The results of the tension tests were preferable to penetration and shear tests. For tension tests, work decreased from 21,693 N mm for new samples, to 6658 N mm after 14 months. Based on elongation at break data, the shelf life of polyethylene covers was 12 months under the tested environmental conditions. This illustrates the effect of arid conditions and age on the mechanical deterioration of polyethylene films. The presented data can be utilized to predict the deformation and mechanical behavior of greenhouse polyethylene covers at different exposure times under arid conditions.