

Physico-Chemical nanomaterials science

Structural peculiarities of PE-80 and PE-100 polyethylene hot tool welded joints

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Polyethylene (PE) is the most widely used polymer, which is used for pipes' production. PE has many advantages comparing with other materials from the point of view of the price, mechanical properties, and the ability to be welded. Despite the development of various methods of plastic pipes welding, mechanism of welded joints formation is still not understood completely. In this context, the aim of this work was a comprehensive study of the structural organization of the welded joints of technical polyethylene of various brands.

Two types of high density industrial polyethylene (HDPE) - PE-80 and PE-100 – were used for the welding experiments. Experimental welding of the polyethylene specimens of both types were performed by means of the traditional hot tool butt welding.

The structural organization of PE-80 and PE-100 and their welds was investigated by means of WAXS.

Wide-angle X-ray diffraction analysis of PE-80 and PE-100 and their welds has shown that all of these materials are characterized by amorphous-crystalline structure. This is indicated with two crystalline peaks against the background of the amorphous halo. Formation of the weld is accompanied with a redistribution of intensities of diffraction peaks that characterize the crystal structure of each polyethylene. This indicates that the crystal planes of polyethylene during the welding process are oriented in tangential direction (i.e., the weld has more ordered structure). Evaluation of the relative level of crystallinity of polymer systems has shown that for both types of polyethylene crystallinity level is almost the same (PE-80 – 56%, PE-100 – 57%), while in the welded joint the degree of crystallinity is significantly higher and is equal to 66 %. The crystallites' size has also been investigated. For PE-80 and PE 100 the average crystallite size is $L \approx 7,2$ nm, while for the welds the average size is 7,6 nm.

Basing on these data we can conclude that during the hot tool butt welding of PE-80 and PE 100 the new and more ordered crystalline structure is formed.