Analysis of the selection of non-destructive testing parameters for multilayer aramid composites by ultrasonic thermography

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Due to their exceptional strength parameters, fiber-reinforced composites are used in both military and civilian applications. Products made of composite reinforced with aramid fibers, which are most often used in military applications, are difficult objects for non-destructive testing. One of the most effective testing methods in their case is ultrasonic thermography. Thermographic methods of non-destructive testing are usually non-contact methods, but one exception is the method of ultrasonic thermography, in which thermal stimulation of the tested material is generated by means of ultrasonic waves. The transducer through which ultrasonic waves are transmitted to the tested object should have good contact with its surface; however, it is difficult to ensure this good contact if the surface of the examined object is not smooth or its shape is not flat. To improve this contact, various types of lubricants or thin aluminum foil is used. Lubrication is effective with low-power generated ultrasound but at greater power at the point of contact with the surface being tested, it quickly heats causing the lubricant to melt. Therefore, detection of defects is highly influenced by the frequency of the applied ultrasound. The paper examines the possibilities for improving the results of defect detection in samples of a multilayer aramid composite used for the production of composite helmets. The surface of these products is rough which hinders good adhesion of the ultrasonic transducer and, due to the thickness of the material being tested and its surface type, sufficient ultrasound power must be generated which excludes the use of surface lubrication. The possibilities of using ultrasonic transducers having different contact surfaces with the tested material were analyzed, selecting the most effective together with the appropriate frequency of generated ultrasounds. The paper presents these results for both computer simulations and experimental tests.