Application Note N37e

Non-destructive Testing of WPC Planks using the Non-Ionising Direct Imaging NIDIT procedure

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Introduction

One of the most powerful procedures of non-destructive testing is X-ray based radiography or radioscopy (RT). Especially the possibility for direct imaging, the high spatial resolution, and the extension possibility for tomography are very attractive. However, X-rays are ionizing and therefore dangerous. Therefore elaborate security measures are necessary and limit practical applications.

In case that the device under test (DUT) consists of insulating material and that the high spatial resolution of the X-ray based testing is not necessary, an alternative is direct imaging testing with microwaves (NIDIT – Non-Ionizing Direct Imaging Testing). Microwaves are non-ionizing and therefore not dangerous. Because of this for example the harmless use of mobile telephones is possible.

In the following the non-destructive testing of WPC planks with the NIDIT procedure is described (WPC – Wood Plastic Composites).

Test Methode

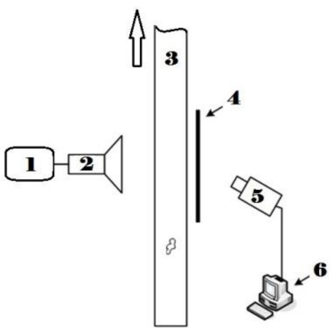

Figure 1: Principal NIDIT test setup with a WPC plank

Figure 1 shows the principal test setup. Low microwave power (24 GHz) is generated in the source 1 and, using the antenna 2, irradiation is widespread onto the DUT 3 (WPC plank). On its back side there is a microwave absorbing foil 4. The microwave radiation, which is uniform on the front side, is affected by defects within the DUT. Accordingly, a non-uniform microwave distribution is incident onto the foil. In this way defects induce a non-uniform heat distribution which is detected by the infrared camera 5 and can be displayed as an image of the DUT inner structure by a computer 6. This heat image is also affected by the geometry of DUT, similar as in X-ray testing.

Test results

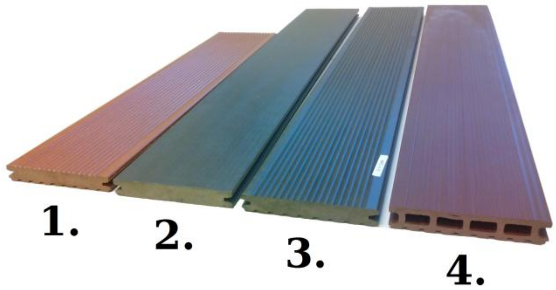

Figure 2: Tested WPC planks. From left: 1. Profiled with crack, 2. Plane with crack, 3. Profiled without defects, 4. hollow chamber profile with defects.

Figure 2 shows the inspected sections of WPC planks with thicknesses ranging from 22 to 25 mm. Only at the end face of the plank with hollow chamber profile defects were visually recognizable.

In order to improve the recognizability of defects it is suitable to use the NIDIT procedure in a differential mode. That means that the current image of the DUT is compared with that of a defect-free reference part. Then the difference image is displayed. - The present tests simulate an inline test during the extrusion of a plank where the plank is moved and the test system is fixed. In this situation, the reference image may be taken as one NIDIT image which was generated slightly earlier as the current one and being a few millimeters apart. In this way, video sequences were taken when the WPC plank moved through the fixed test setup. In this way, step by step the changes of the raw images were displayed. These video sequences are attached to this application note. Here single differential images are shown.

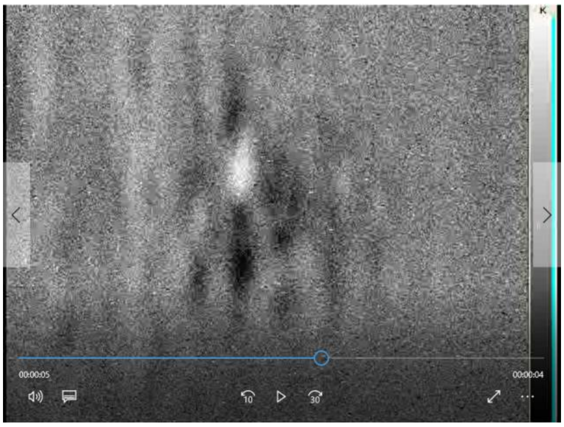

Figure 3: NIDIT image of the profiled plank 1 in the region of the crack.

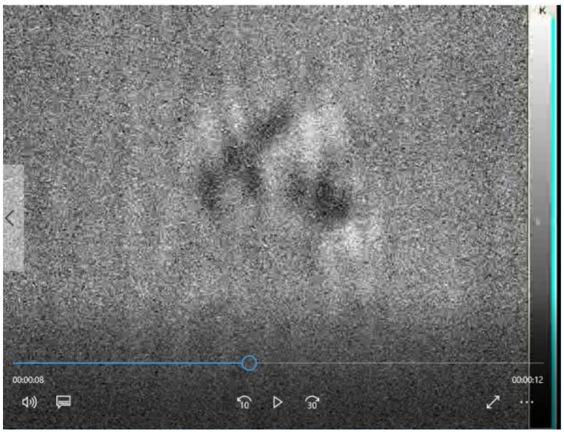

Figure 4: NIDIT image of the plane plank 2 in the region of the crack.

Figure 3 shows the NIDIT differential image of the profiled plank in the region of the crack. This can clearly be recognized.

Figure 4 shows the corresponding NIDIT differential image of the plane plank in the region of the crack. Also this one can clearly be seen.

For comparison, figure 5 shows a typical NIDIT differential image of the defect-free profiled plank 3. The intensity of the grey is very uniform without recognizable defects.

Figure 5 shows a single image of the NIDIT video sequences of the plank with a hollow chamber profile. The indications extend over the complete section length of about one meter and are mostly limited to the inner two of the four chambers.

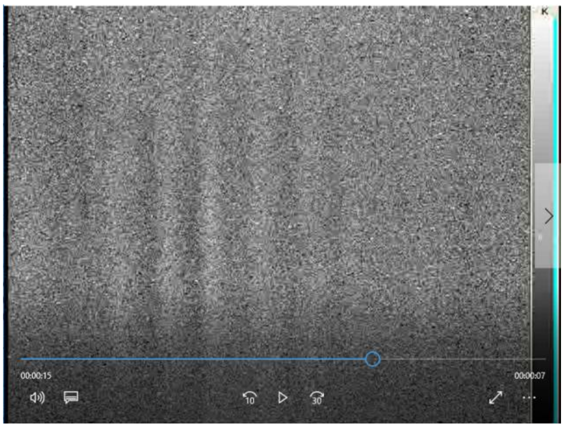

Figure 5: Typical NIDIT image of the defect-free profile plank 3.

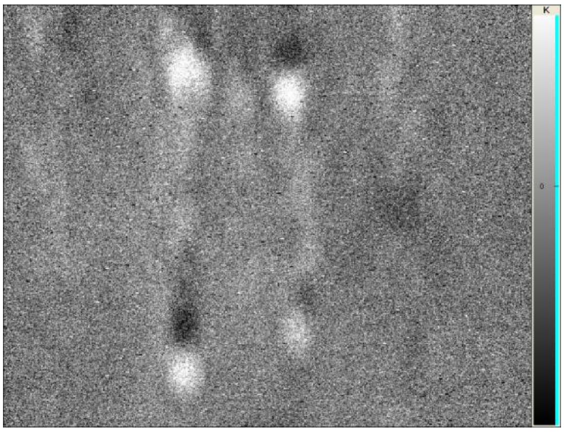

Figure 6: NIDIT snapshot of the plank 4 with hollow chamber profile showing a typical defect image.

The background of these images is rather fine-grained. According to the needs in single situations, the images can be post-processed and smoothed. In this case, the recognition threshold of these rather large area indications can furthermore be reduced. However, the spatial resolution would also be reduced.

Conclusions

This application note briefly describes the direct imaging NIDIT procedure and its application to the NDT of WPC planks. Cracks in the DUTs 1 to 3 were known from earlier tests with other methods and were clearly recognized with NIDIT. The DUT with hollow chamber profile is of commercial practice and bought in a construction market. No tests with other methods were performed. The defects were unknown before.

The tests of the above presented procedure were performed in a laboratory. They can be transferred as inline tests during the extrusion of WPC planks.

Attachment: Video sequences

Profiled WPC plank 1 with crack
Plane WPC plank 2 with crack
Defect free profiled WPC plank 3
WPC plank 4 with hollow chamber profile and defects

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