THE PARAMETERS OF EXPLOSIVE LOADING OF WOOD

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One of the applications of such a widespread material as wood is using it as a protection against the effects of short-term dynamic loads (impact or explosion). In this paper, in addition to the previously discussed processes of shock wave attenuation during its propagation in the material [1], we present data on other aspects.

The experimental assembly consists of a birch sample shaped as a plate measuring 15×30×150 mm and an explosive layer applied to its surface. When an explosion is initiated, a sliding detonation propagates along the sample, generating an oblique shock wave in the material. At a given moment in time, an instantaneous image of this process is recorded by means of pulsed radiography. In the coordinate system bound to the detonation front, the flow is a stationary process: the initial HE flows into the stationary front at detonating velocity D and flows out at the velocity reduced by the velocity of explosion products. Similarly, the initial uncompressed wood flows into the shock wave front and flows out as a compressed flow. This stationarity makes it possible to determine the flow velocity parameters, and it constitutes a problem studied in [2]. The paper considers the following areas.

1. Movement of the sample–explosive products interface.

The interface profile is recorded as an X-ray pattern. The curved shape of the profile indicates a decrease in the interface velocity from the initial value and serves as a source for calculating its values. Each point at the initial unperturbed position of the interface moves during time $t = l/D$, where l is the distance from the point to the detonation front. It is possible to obtain the position of the points of the interface at various times. Based on this motion diagram, we have determined the velocity of points that decreases from the initial value of about 2 km/s as the shock wave propagates deep into the wood.

2. Dynamics of average compression of bulk wood covered by the pressure pulse.

At each time, the bulk of compressed wood is located between the points of the shock wave front and the interface. The difference of their velocities results in the increase in volume of the compressed bulk over time. In the meanwhile, the average compression intensity decreases. In the studied time range (0.5…5 μs), it varies from 2.5 to 2.

3. The amplitude values of the initial pressure at the surface of the sample.

Explosive loading generates a pulse affecting the material with an effective duration of microsecond range with a profile descending from the initial pressure. The amplitude pressure value is determined using the P–α diagrams. The sought value is determined as a point of intersection of two curves in the P–α plane: the curve of lateral expansion of explosive products, and the corresponding wood diagram. It is approximately 2.5 GPa.

References

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