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Obtaining of stress-strain laws of visco-plastic materials from measurements of temperature increase associated to its plastic deformation

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The analytical expression of the hardening law usually includes parameters which values must be determined for each material. These parameters are generally obtained by adjustment to the stress-strain relation obtained in a compressive and tensile uniaxial or torsion tests. In dynamic tests due to the reached high deformation velocity, the deformation process can be considered adiabatic. The material temperature increase can be calculated from the plastic work obtaining an expression that includes the parameters of hardening law as variables. By other way, the heat generated in the material during the test can be estimated by measuring the temperature increase of specimen surface during compressive tests using the technique of infrared thermography. A methodology for metallic specimens testing in universal compression machine (quasi-static tests) or Hopkinson bar (dynamic tests) with simultaneous measurement of temperature increment was established. The base of this methodology is a test system including a test camera, a dark camera, a synchronism system and several measurement systems joined to the mechanic tests machines. As application of this methodology an alternative procedure for determining the hardening law parameters by measurement of the temperature increase in compressive Hopkinson bar tests was developed. The procedure was applied to estimate the parameters of the Johnson-Cook law of an aluminium alloy (Al 6082).