Available online at www.sciencedirect.com

ScienceDirect

Procedia Materials Science 8 (2015) 148 – 154

Procedia Materials Science

www.elsevier.com/locate/procedia

International Congress of Science and Technology of Metallurgy and Materials, SAM - CONAMET 2013

Analysis of the Acoustic Emission in a Reinforced Concrete Beam using a Four Points Bending Test

Carlos Guzmán[a], Darío Torres[a], Cynthia Hucailuk[a], Dino Filipussi[a,b]*

[a]*International Centre of Earth Science GAIyANN, Centro Atómico Constituyentes, Comisión Nacional de Energía Atómica, Av. Gral. Paz 1499, Buenos Aires (1650), Argentina*
[b]*Universidad Nacional de San Martín, Escuela de Ciencia y Tecnología, M. de Irigoyen 3100, Buenos Aires (1650), Argentina*

Abstract

In the present work, the mechanical behaviour of a reinforced concrete beam was evaluated in a four points bending test. For this purpose, a configuration of two Acoustic Emission (AE) sensors, tuned in 150 kHz, was set and at the same time. The load-displacement curve was implemented by using a load cell and a LVDT. The characterized concrete beam corresponds to a type of high performance H80 without shear reinforcement. Different levels of damage in function of the AE parameters measured were evaluated in function of load percentage. The aim of this study is to identify parameters of EA such as b-value, RA, that could be relevant in the mechanical behaviour of the beam.

Selection and peer-review under responsibility of the scientific committee of SAM - CONAMET 2013

Keywords: acoustic emission; beams; reinforced concrete; b-value.

* Corresponding author. Tel.: 05411-6772-7990; fax: 05411-6772-7134.
E-mail address: guzman@cnea.gov.ar

Selection and peer-review under responsibility of the scientific committee of SAM - CONAMET 2013
doi:10.1016/j.mspro.2015.04.058

1. Introduction

Acoustic Emission (AE) is the name of the physical phenomenon that consists of elastic waves generation in a material when it is subjected to stressing and is due to the change of its deformation or stress field. Registration of these signals is known as a non-destructive test method (NDT).

AE is classified as a passive NDT since it needs elastic wave sources as nucleation or crack propagation in the material. In NDT method, elastic waves are produced in the material and then, these waves can be detected accounting for defects existence or present damages in the studied structures. The main objective of AE is to provide valid information to predict a possible catastrophic failure or to evaluate the level of damage in a material. Generally, piezoelectric transducers are used for the detection of signals, broadband or tuned, which transform mechanical wave into an electrical signal. The typical parameters that characterize these AE events are: amplitude, duration, rise time, energy, RMS and counts. In Fig. 1, it is shown the typical parameters of AE discrete electrical signal at the output of a sensor, called burst.

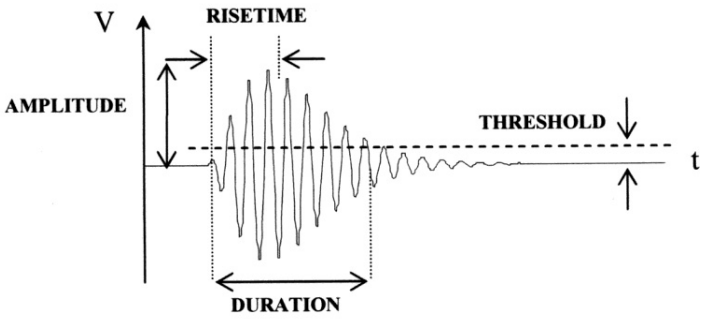

Fig. 1. Typical parameters in an electrical signal of AE event.

The b-value is an important parameter to study as it is a good indicator of the state in which the damage progresses in terms of the structural integrity of the studied beam. The mathematical expression arises from the Gutenberg-Richter formula commonly used in seismology:

$$\log N = a - bM \tag{1}$$

where N is the number of earthquakes of magnitude greater than M, b is an empirical constant and M is the Richter magnitude of earthquakes.

In the AE case, that formula is rewritten as:

$$\log N = a - b\left(\frac{A_{db}}{20}\right) \tag{2}$$

in this case, N is the number of events with amplitude greater than the threshold value used, A is the amplitude value of those events in decibels (dB) and b is an empirical constant, but in the last case b is called “b-value”. Other typical parameters of AE used in this work are: medium frequency and duration,

$$MediumFrequency = \frac{Counts}{Duration} \tag{3}$$