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Indentation Fracture of Bovine Cortical Bone: Acoustic Emission Technique

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INDENTATION FRACTURE OF BOVINE CORTICAL BONE: ACOUSTIC EMISSION TECHNIQUE

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INTRODUCTION

Indentation cutting may result in microcracking and main crack growth which was previously reported [1]. In this study, we recorded the AE signals produced by cracking processes during cutting on cortical bone, measuring the cutting force and correlating between load-displacement curves and AE activities.

MATERIALS AND METHOD

8mm cubic specimens of cortical bone (n=13) were successfully cut to complete fracture in the longitudinal axis by a 60° wedge blade mounted on a Hounsfield Universal Testing Machine at a constant crosshead speed of 1mm min⁻¹. Cutting force was measured using Kistler dynamometer and AE signals were recorded using AE sensor (PCI-2) and amplified by a fixed gain of 40dB with a (0.1-1) MHz band pass filter. A post-test threshold value of 40dB was used to eliminate unwanted noise signals. Both force and recorded AE parameters were displayed using AEWIn (PAC). The numbers of AE counts were plotted against the load ranges which was based on the percentage of maximum load at fracture.

RESULTS

After cutting, the mean of total number of AE counts and produced absolute energy at chosen load range intervals up to maximum were analysed using Minitab and represented by 95% confidence intervals (see fig. 1). Table-1 shows a significant increase in AE counts during and at fracture point (between 90% and 100% at maximum load). It was found that the range of signals amplitude varied between 40 and 98 dB., and the value of pooled mean of amplitude was 54.33 dB (S.D = 2.4). The highest amplitude signal which had an amplitude value of 98 dB was observed at fracture point.

Table-1 Mean of AE counts

Load levels (% of Max. load)	mean of counts
30-40	7
40-50	47
50-60	90
60-70	50
70-80	400
80-90	523
90-100	5482

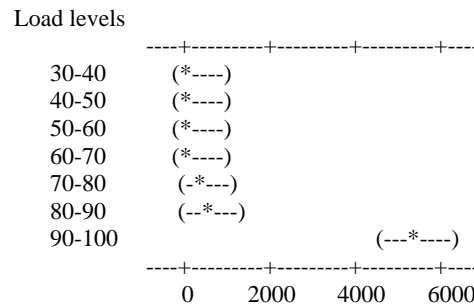


Figure 1: Individual 95% CIs for Mean values of AE counts based on pooled standard deviation

DISCUSSION

It is hypostasised that the sudden rise in the number of AE counts which was associated a very fast crack growth at final fracture [2]. The small value of pooled mean of amplitude (54.33 dB) suggested that most of hits maybe related to weaker events such as microcracking prior to occurrence of highest amplitude signals (98 dB), which was as a result of unstable crack growth at fracture [2].

REFERENCES

- [1] Reilly G.A. (*et al*), Bioengineering in Ireland 11, Dublin Ireland: 21, 2005.
- [2] Akkus, O. (*et al*), J. Materials Science, 35: 6065-6074, 2000.

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