Evaluation of shot peening impact force by AE method

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Abstract

Currently, there are some methods of management before and after peening. However there is not method of management during peening. More reliable processing is enabled by the monitoring of a state processing and preservation of the data. Therefore we focus on AE method to evaluate shot peening impact force. As a result, AE parameter is varied by intensity and media diameter. Impact position can be obtained by AE. However when projection density is a lot, there is a problem due to overlap of AE wave. As a result, AE method is difficult under conventional condition. However we can analyze phenomena on shot peening by AE.

Keywords AE, AE sensor, intensity, coverage, hardness, impact position

Introduction

Currently, intensity and coverage are used for process management on shot peening. After shot peening, residual stress and hardness are evaluated for peening effect. However none of these parameters can be evaluated during processing. If we can confirm the shot peening effect during processing, we can propose good benefit to our customer. More reliable method can be obtained by monitoring during peening and data accumulation. Therefore we focused on AE method.

Acoustic emission (AE) is a phenomena in which elastic energy is released by cracking or transformation of solid materials. The AE method is an in situ, non-destructive evaluation method, which detects the elastic wave with a piezoelectric sensor.

In this study, we evaluated shot peening using the AE method.

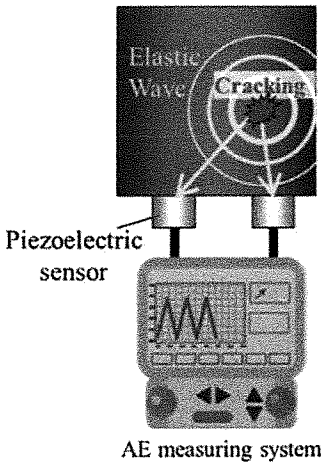


Fig.1 AE measuring system

Experiment

Specimen and experiment method

Wheel type shot peening machine were used. The velocity were used 30m/s to 88m/s. Table.1 shows the kind of media. SCM440 is prepared for specimen. Table.2 shows chemical composition of specimen. Fig.2 shows diagram of this experiment. The sensor is attached on the backside of a workpiece. The signal is recorded by called CWM (Continuous Wave Memory) [1]. The specimen is set on the base that is spread rubber. In order to control the impact media, cabinet was installed that is opened upper side. Control plate was set on the cabinet due to adjust the number of impact media.Fig.3 shows an example of AE wave. Horizontal axis shows time and vertical axis shows AE amplitude. 1st peak amplitude was selected for evaluation. 1st peak amplitude means applied force on the material surface.

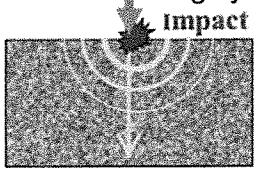


Table1. The kind of Media

Type	Diameter [mm]	Vickers hardness
Cast steel	6	450
CCW	6	500
CCW	6	600
CCW	6	700
CCW	6	815
Cast steel	10	450
Cast steel	14	450

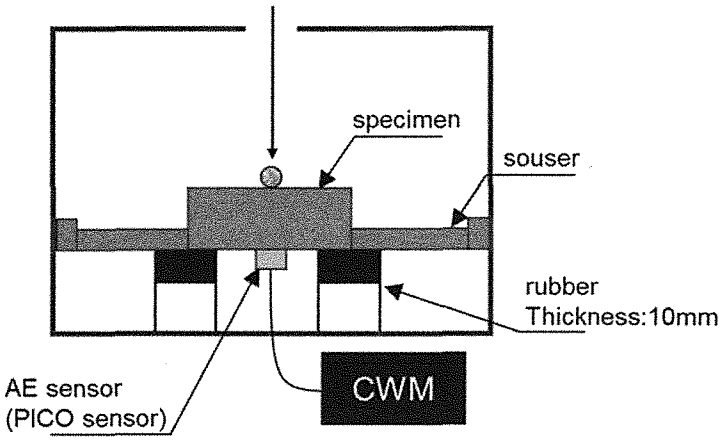


Fig.2 Diagram of experiment

Table2. Chemical composition (wt%)

	C	Si	Mn	P	S
SCM440 (JIS)	0.38	0.17	0.64	0.016	0.003
	Cu	Ni	Cr	Mo	
	0.16	0.10	1.04	0.17	

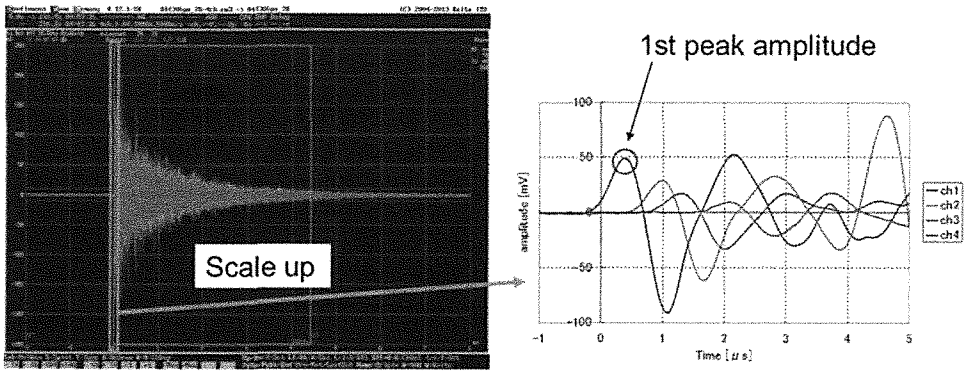


Fig.3 Sample of AE wave

Charasteristic of AE

Characteristic of AE is evaluated during shot peening process. Saucer catch all of the media after peening in order to compare total amount of AE event and total number of media.

Impact position

The generating position of AE and the strength of media impact can be obtained by impact position. In this experiment we use four AE sensor. They are set on the back side of specimen. The generating position of AE is calculated by time difference of each channel.

Influence of coverage, intensity and hardness

Influence of coverage, intensity and hardness were evaluated. Fig.4 shows the location of AE sensor.

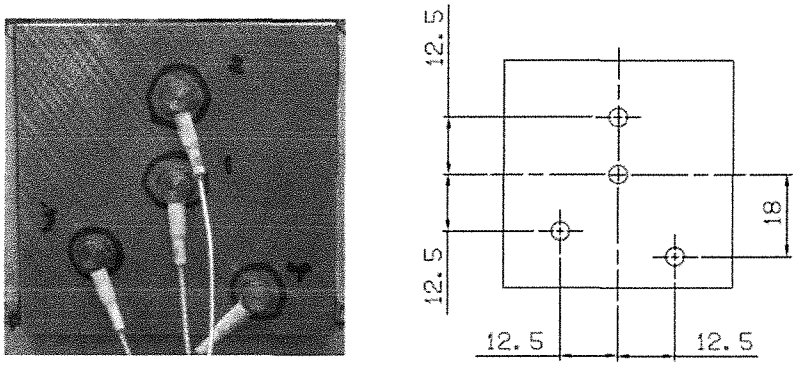


Fig.4 Location of AE sensor

Results

Fig.5 shows relationship number of AE event and number of impact media. Horizontal axis shows number of impact media and vertical axis shows number of AE event. In this experiment, one million media is projected by wheel turbine. However eventually, 30 thousand media impact on the surface through to control hole.

As a result, number of impacted media and number of AE event is almost same. Therefore, number of impacting media can count by AE method.

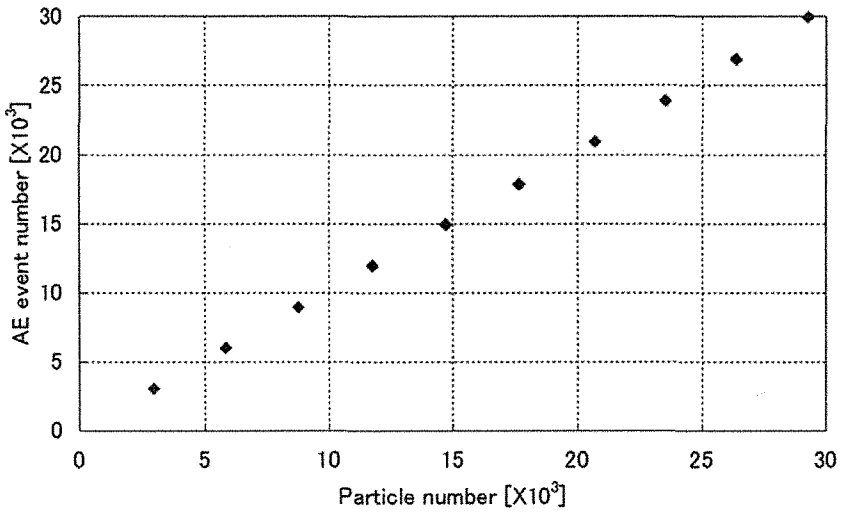


Fig.5 Relationship AE event and number of impact media

Fig.6 shows the calculated impact position and actual impact position. As a result, the calculated impact position is almost same as actual impact position.

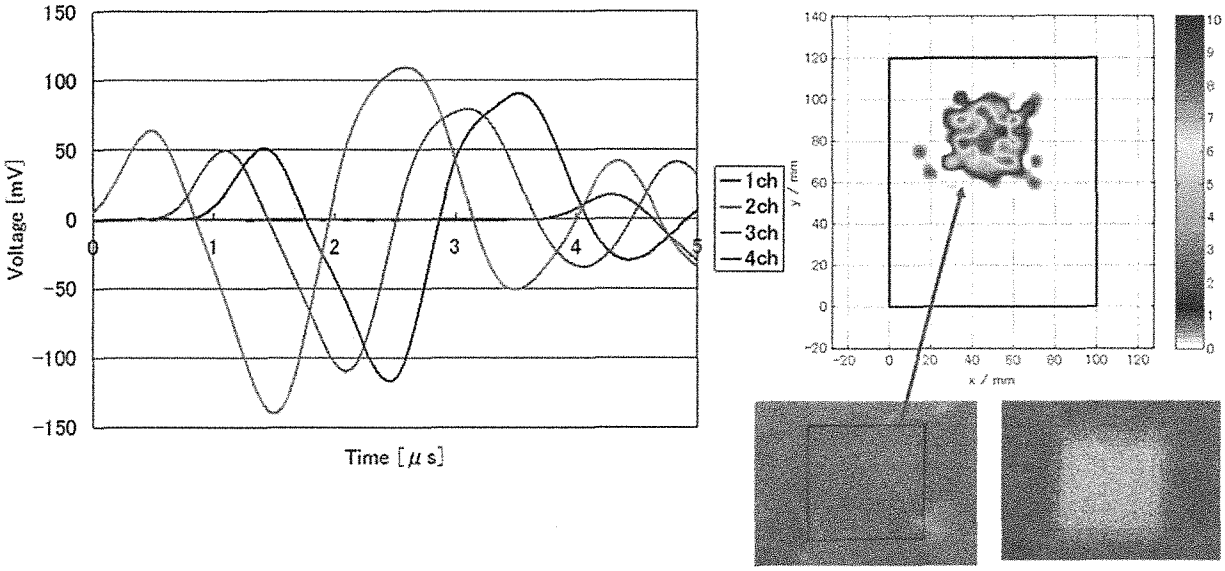


Fig.6 The calculated impact position and actual impact position

Fig.7 shows relationship AE and coverage. Horizontal axis shows number of impact media and vertical axis shows 1st peak amplitude and WT peak frequency. WT means wavelet transform. 1st peak amplitude and WT frequency is constant. Therefore, 1st peak amplitude ant WT frequency are almost same, before and after peening. The influence of work hardening is very small against AE event.

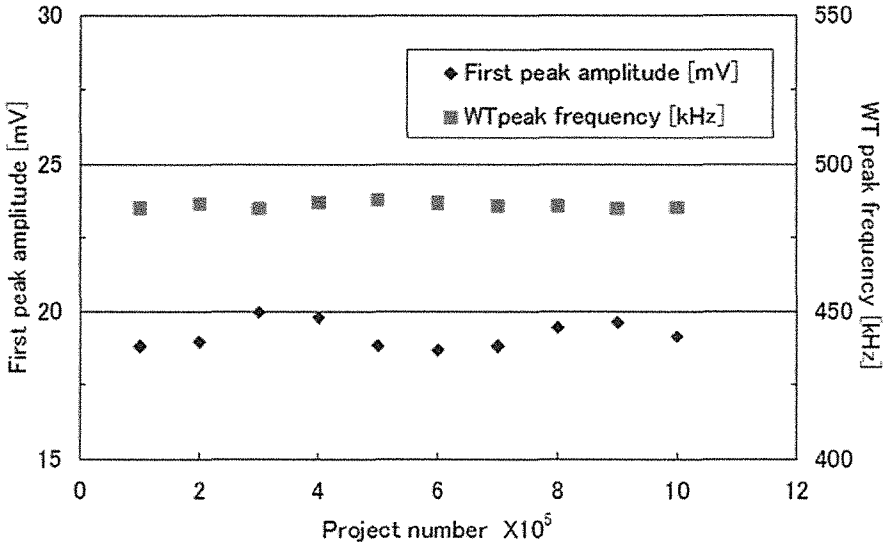
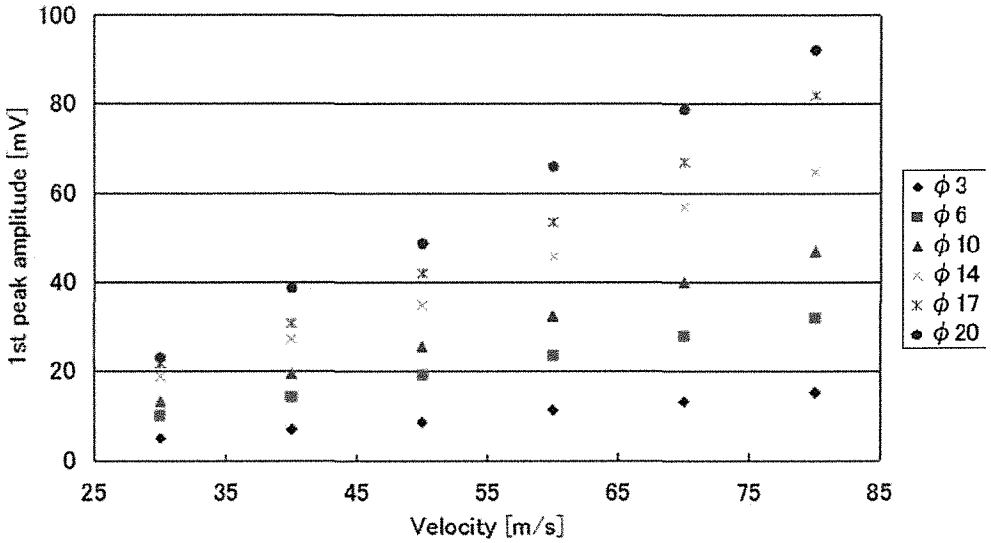


Fig.7 Relationship AE and coverage

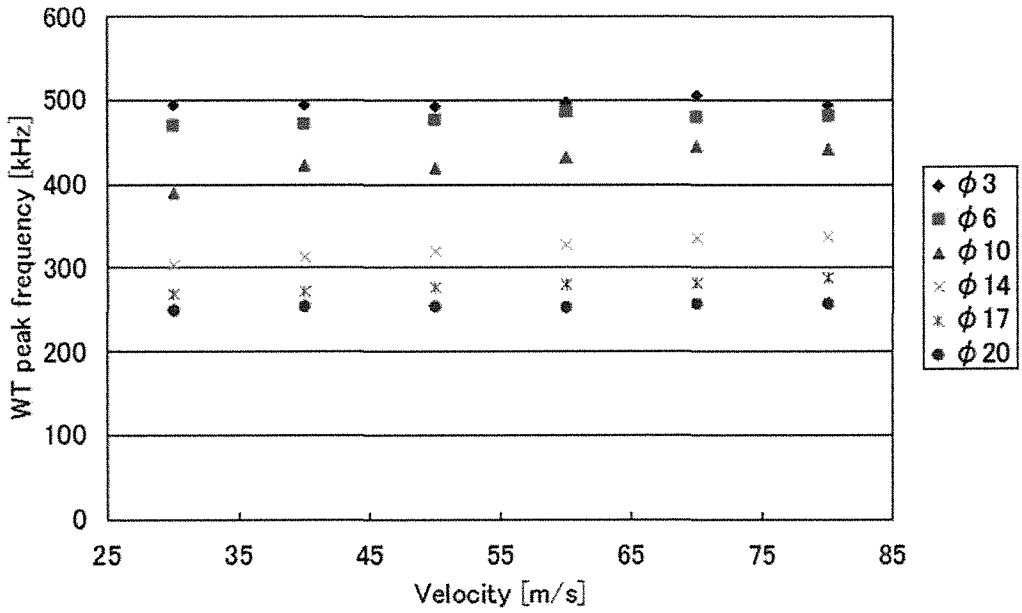
Fig.8 shows relationship 1st peak amplitude and intensity. Horizontal axis shows velocity and vertical axis shows AE parameter. Because of intensity is proportional to velocity, the result is organized by velocity. When velocity increases, 1st peak amplitude increases. The diameter becomes larger as the slope becomes steeper. When velocity increases, WT peak frequency is constant. The diameter becomes larger as WT peak frequency becomes lower. As a result, difference in diameter of media is varied by AE parameter. Intensity is varied by 1st peak amplitude. However intensity is not varied by WT peak frequency.

Fig.9 shows relationship 1st peak amplitude and hardness of media. Horizontal axis shows velocity and vertical axis shows 1st peak amplitude. We provide the media that diameter of

media is the same and hardness of media is different. We test it using them. As a result, a big difference is not seen.
Therefore, we can confirm that there is not influence on 1st peak amplitude by difference media hardness.



(a)1st peak amplitude



(b)WT peak frequency

Fig.8 Relationship AE and intensity

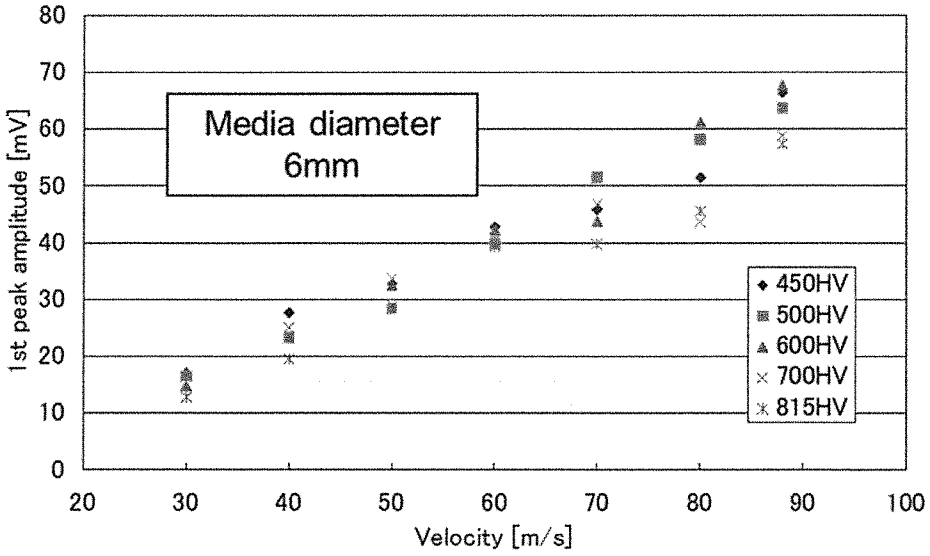


Fig.9 Relationship AE and hardness

Conclusion

It is not possible to measure AE wave under conventional condition of projection density. At projection density is low:

1. Number of AE event and number of impacted media are almost same.
2. The calculated Impact position is almost same as actual impact position.
3. There is proportional relationship between 1st peak amplitude and intensity.
4. There is not influence on 1st peak amplitude by difference media hardness.

[1] K. Ito and M. Enoki, Mater Trans.48 1221-1226 (2007)