CONDITION MONITORING THROUGH STICK SLIP MOTION OF BRAKE PADS

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1. SUMMARY

Stick Slip motion is used to monitor the life of a special material fabricated for brake pads, through the acoustic and vibration outputs. A description of the stick slip motion is given and details of parameter monitoring are outlined. Sample analysis of Acoustic and Vibration outputs from the stick slip motion with electron microscope photographs are presented and discussed.

2. INTRODUCTION

Stick slip motion has been investigated and described in (1-8). A brief outline will be given here for completeness. It is in essence the motion of two slow moving bodies in frictional contact, in which one of the members is driven elastically. The motion is the result of forces in the elastic member reaching a magnitude greater than the static frictional force between the two bodies. When the driven body is rotated as a result of these forces the slip phenomenon occurs. The stick phase is initiated when the rotation ceases due to an increase in the frictional force.

The paper will show the result of an experiment where noise and vibration during stick slip motion using a hardened steel disc and a brake material are in frictiional contact.The brake material has the commercial name "RC" and is the product of a well known brake manufacturer. This material has already had some initial tests which have been summarised in (9). Howeverver, further work has been done and the resutls are presented in this paper.

CONDITION MONITORING - STICK SLIP

It is important that the surface contact be sustained over a time period in order to study the relationship between the parameters of stick slip and the acoustic output against any surface changes which may occur.

The instrumentation has already been described;details are given in references (1 - 5) and need not be detailed here. Suffice to say that the vibration was measured by an accelerometer mounted near the rolling member and the noise by a microphone situated near the contact. Both signals were monitored on a Real Time Analyser and precision grade instrumentation (B&K) was used throughout.

3. RESULTS

In (8-9) it was suggested that there is a reduction in energy over the duration of the stick slip and a sudden upsurge just before brake squeal. The detailed history of the stick slip at 15 minute intervals is given in Figure 1 (where the distiction for this discussion is the time elapsed at the top of the figure). The comparison of the sound and vibration in Figure 1 shows that the acoustic output is the result of vibration mainly at resonances in the system, note the fundamanetal resonance at 600 Hz.

A consistent noise radiation from the vibrating system.
as the stick slip progresses is exhibited to-gether with a reduction in the radiation energy.The radiation energay from the 45 and 60 minutes of stick slip time. This may indicate that there is acoustic damping generated as the stick slip progresses. After this there is a sudden increase in energy at 75 minutes which is the onset of screech or brake squeal. The energy of the spectra is related to the spectral width.

It was shown in (9) that the energy reduces by a factor of four from the start of the stick slip up to 60 minutes and after this time interval there is an increase in spectral width and an increase in spectral energy by a factor of 4.5.

The accompanying electron microscope readings Figure 2 taken from the surface of the specimen show that there is no change in the surface texture from the start to 60 minutes, whencefrom at 75 minutes there is a distinct change.

It should be noted that the light areas are evidence of metallic elements in the surface. It would suggest from this that the constant slippage of the materials in contact reduce this surface and hence reaches a point where there is pure fibrous pads in contact causing the onset of screech. At this juncture this is a hypothesis and suggests that metallic asperities in the material mitigate the propensity to brake squeal and that as evidenced by the wearing down of these metal particles the onset of squeal occurs.

4. CONCLUSIONS

The incipient stages of squeal is the result of a sudden upsurge in spectral energy both to the vibration and acoustic spectra as evidenced by the results. In essence the condition monitoring of the brake material predicts the onset both of wear and brake noise.

5. REFERENCES

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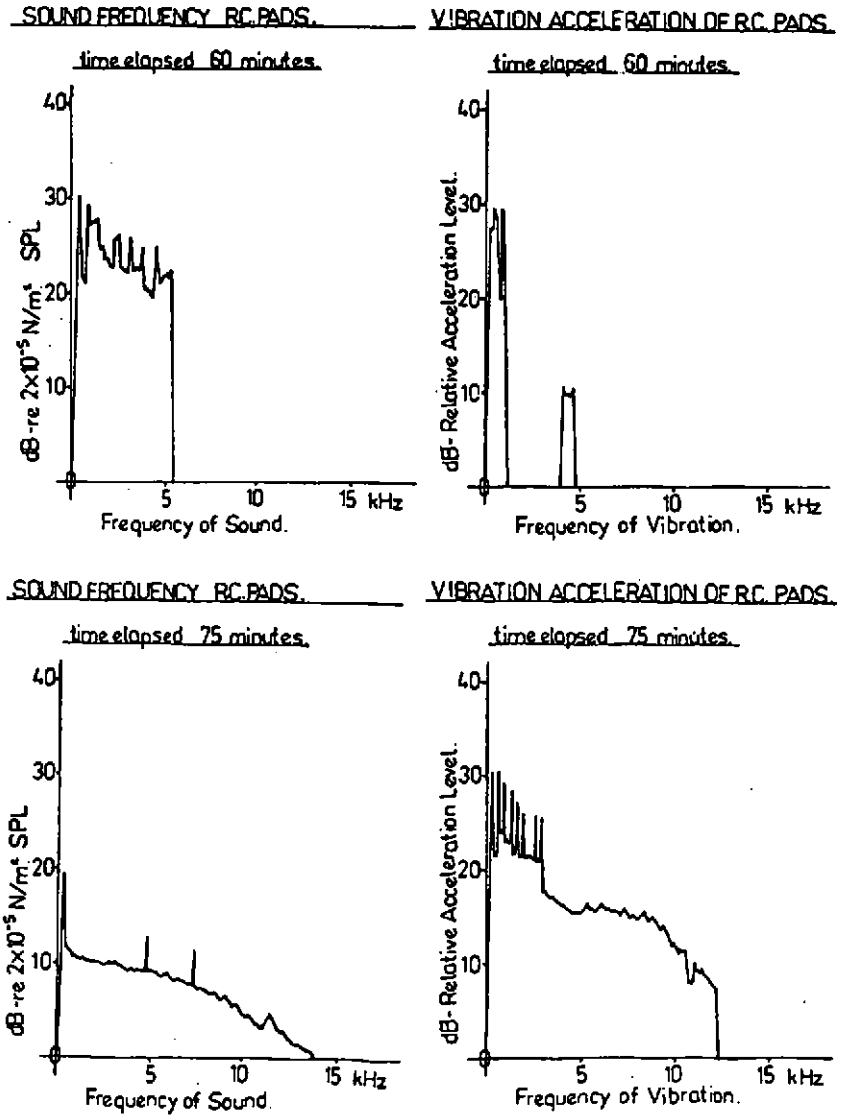
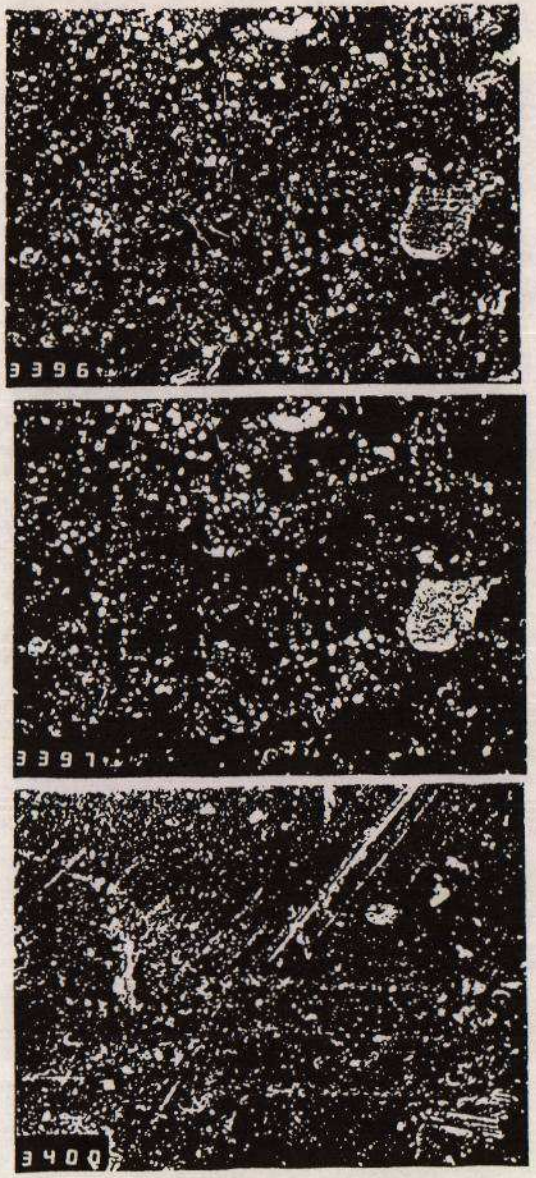


Stick slip Acoustic and Vibration Spectra after time intervals of fricitonal contact.

FIGURE 1



Electron Microscope photographs of surface of brake specimen
Key to photographs:

Top	At the start of the frictional contact
Middle	After 60 minutes of frictional contact
Lower	After 75 minutes of frictional contact

FIGURE 2