Ann. Occup. Hyg. Vol. 13, pp. 33–36. Pergamon Press 1970. Printed in Great Britain

REMOVING DUSTS FROM BRAKE ASSEMBLIES DURING VEHICLE SERVICING— ALTERNATIVE CLEANING METHODS*

G. L. LEE

British Leyland, Longbridge, Birmingham

PRELIMINARY CONSIDERATIONS

WHATEVER the criticisms may be from an occupational health point of view, few would deny that the operation of removing brake dusts with an air line is efficient in that the total time to perform the task is extremely short. The time required to perform an operation is of vital importance in industry and any process changes will always be judged relative to the time scale. In addition, the effort required from an operative in using the method should be minimal and it is easy to see that the chances of developing a technique of cleaning which will reduce dust emissions but at the same time require no more time and effort are extremely slim. Quite clearly, we must concede from the very beginning that some increase in time and effort involved is inevitable.

When viewed under normal lighting conditions, the result of applying a compressed-air line to remove brake dusts is very dramatic. Unfortunately, mere dramatisation alone is not adequate to describe the emission of dust from a process; more objective methods are needed. The conventional method of evaluating an environmental condition is the measurement of the appropriate parameter (in this case—fibre counts), referring the results to hygiene standards. In experimental work to evaluate dust control methods, simpler, "relative" techniques of measurement have considerable advantages and part of this work is concerned with applying a fairly simple method to define certain environmental conditions which prevail when brake dusts are removed by blowing out with a compressed air line and comparing these with the conditions obtained when a dust control technique is applied. Because the method is a relative one, care to prevent errors from extraneous sources of variation is important. These sources of error are discussed later.

METHODS USED TO EXAMINE ENVIRONMENTAL CONDITIONS

When dusts are released in relatively small quantities it is often impossible to see the clouds under normal lighting conditions. They can be made visible using the Tyndall Beam effect and this has been employed extensively during the experimental work.

*This paper was originally presented at a Conference on Exposure to Asbestos during Brake and Clutch Maintenance, held at Brentwood, Essex, March, 1969.

Mass concentrations of airborne brake dusts were determined at two positions by sampling through tared membrane filters. In the first position, a static sampler was placed close to the sources of dust emission. Generally, this sampling position was chosen to be in the area where the results of Tyndall Beam examinations had indicated that the highest dust concentrations were likely to be obtained. Secondly, a personal air sampling device was worn by the operative in such a manner that the sampling head was attached to the wearer's lapel, as near as practicable to the breathing zone.

Samples for particle counting were taken, again in the operative's breathing zone, using a Konimeter, and membrane filter samples were also taken for subsequent fibre counts by microscopy, using the method described by ADDINGLEY (1966). Possible weighing errors due to static charges on membrane filters were prevented by weighing in a field of ionising radiation, as described by HIGGINS and DEWELL.

The results of fibre counts showed that the numbers of fibres present in the high total dust concentrations obtained when an air line was used were of a low order of magnitude and hence the total dust concentration was used as a relative method to describe the dustiness of the environment.

The location selected for the experiments was in a workshop area, behind a glazed partition, and well away from access doors, so that comparisons of cleaning methods were not affected by variations in local air movement. Smoke tests were carried out at each sample period to confirm this point.

CONDITIONS OBTAINED WHEN A COMPRESSED AIR LINE WAS USED TO REMOVE BRAKE DUSTS

A commercial vehicle brake assembly, after removal of the brake drum preparatory to cleaning, is shown in Fig. 1. In this particular case, the hub had also been removed for bearing replacement which facilitated cleaning operations. It should be noted that this is not always so and for the majority of our tests the inconvenience of the hub being present had to be contended with.

A series of Konimeter samples were taken during typical operations and also after the process had ceased. The counts for these samples are summarized in Table 1.

TABLE 1. RESULTS OF KONIMETER SAMPLES DURING BLOW-OFF

Sample	Number of brake dust particles/5 cm³
Taken at beginning of operation	5000
Taken approx. 20 sec later	4500
Taken approx. 60 sec later	4000
Taken approx. 30 sec later	1800
Taken approx. 30 sec later	580

It is seen that there is a progressive fall in count as the local dust cloud disperses. The first three figures are approximate only, the numbers of particles collected being too high for accurate counting.

ns by
pier was
tion was
ndicated
personal
ampling
ng zone.
ng zone,
ent fibre
Possible
veighing

the high
order of
thod to

a glazed
nethods
ried out

epara-
so been
ould be
icence of

nd also
Table 1.

perses.
l being

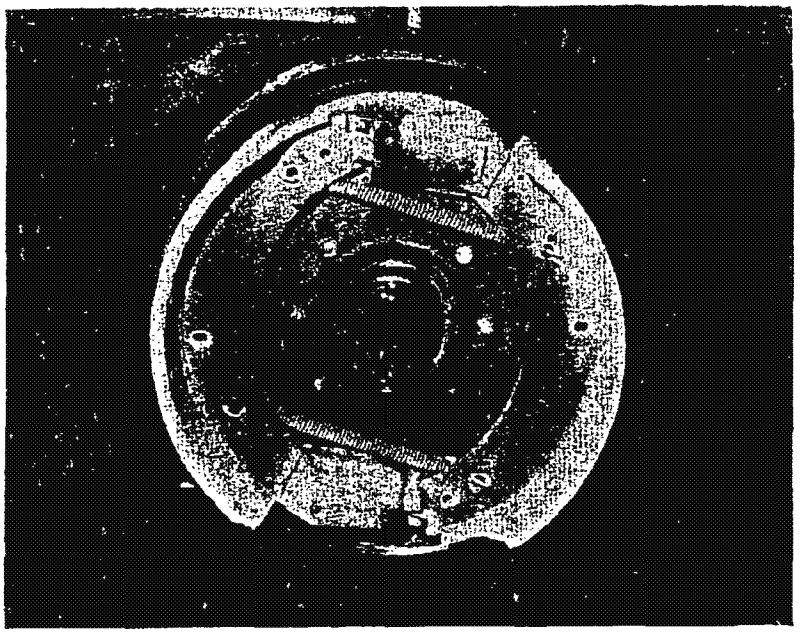

FIG. 1. Brake assembly before cleaning.

(facing p. 34)

A fixed sampling period of some 5 min was chosen for the determination of mass concentrations—this being longer than required for the blowing operation but sufficient to cover that required for the alternative cleaning methods. The dust collected by the static sampler close to the brake assembly gave an equivalent concentration of 114 mg/m³ and that for the personal air sampler 42 mg/m³. It is probable that many of the particles included were larger than respirable size. The few asbestos fibres counted on membrane filter samples gave a concentration of the order 3–5 fibres/cm³.

ALTERNATIVE CLEANING METHODS

Initial approaches were to try the use of fixed and hand-held extractors to collect the dust particles removed by hand-brushing with a small paint brush. Fixed extractors, although reasonably efficient, were rejected because of restrictions which these placed upon the work by confining it to one area. Both operatives and supervision were unhappy about being confined to one work area—preferring to retain flexibility and carry out the work as they had previously done, wherever the vehicle happened to be. Portable extraction equipment was clearly required and after some preliminary enquiries, a BVC industrial vacuum cleaner was selected for use in experimental work. It is of fairly conventional type, powered by a $\frac{3}{4}$ h.p. motor and supplied with disposable paper bags in addition to the normal cloth bag. The paper bags are fitted in a manner which allows them to be sealed fairly easily before removal. To trap any particulates which might pass through the paper and cloth bags, an external, multi-layer filter was provided for fitting to the air outlet end of the cleaner. Preliminary experiments established that some brake dust particles were passing the paper and cloth bags but these were trapped by the externally fitted filter. Sampling at the exit side of the filter established that no particles passed the filter.

CONDITIONS OBTAINED USING THE VACUUM CLEANER AS A SOURCE OF EXTRACTION

The first technique tried was to use the nozzle of the cleaner, hand-held as a source of local extraction whilst the dust deposits were disturbed with a small paint brush held in the other hand. The Tyndall Beam showed that some dust was escaping into the environment. Objective measurements are summarized in Table 2.

TABLE 2. RESULTS OF KONIMETER SAMPLES DURING BRUSHING AND WITH LOCAL EXTRACTION

Sample	Number of brake dust particles/5 cm³
Taken at start of process	1070
Taken about 1 min later	404
Taken about 2 min later	426
Taken at end of process	446

The fixed sampler in the area of the highest concentration gave a dust concentration of 21 mg/m³ and the personal sampler, 2·7 mg/m³.

An improvement in controlling the release of dust had been obtained but was not considered completely satisfactory and an alternative approach was sought.

CONDITIONS OBTAINED USING A MODIFIED TECHNIQUE

After some preliminary experiments, the following general technique was devised. Firstly, the loose deposits of dusts inside the brake drum and on readily accessible surfaces of brake shoes and the brake assembly were removed, using the smallest brush supplied with the cleaner—the equipment being used as a vacuum cleaner. A much narrower, tubular brush, made from available materials was then used to remove deposits from less accessible surfaces. Finally, a rag, soaked in water and wrung fairly dry, was used to remove adherent deposits. No visible emissions of dust were observed but a few particles were detected by the objective methods, as shown in Table 3.

TABLE 3. RESULTS OF KONIMETER SAMPLES DURING MODIFIED TECHNIQUE

Sample	Number of brake dust particles/5 cm³
Brushing with standard brush	16–25
Brushing with tubular brush	20–25
Rag wiping	1–5

No fibres were detected and the mass concentrations involved were too low to determine.

CONCLUSIONS

The objective measurements made seem to confirm that vacuum cleaning provides a useful contribution towards obtaining satisfactory dust control when brake assemblies are cleaned. The design of the particular cleaner chosen prevents the discharge of particles back into the environment and the collection in a paper bag enables suitable disposal methods to be adopted. This work was completed in the early part of 1968 and subsequently the method described was recommended for use until such time as the results of studies being carried out elsewhere in the Motor Industry were known and detailed requirements subsequently formulated.

Acknowledgements—The assistance of Mr D. Smith of the Industrial Hygiene Department and Mr Young, Works Engineers, is gratefully acknowledged.

REFERENCES

ADDINGLEY, C. G. (1966), *Ann. occup. Hyg.* **9**, 73.
HIGGINS, R. I. and DEWELL, P. in *Instruction Leaflet* 3107/A1, C. F. Casella.