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REDUCTION OF NOISE FROM LORRY TRAILERS

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INTRODUCTION

Body rattle of unladen bulk tipper trailers can become the predominant noise source of heavy goods vehicles when travelling over uneven or damaged road surfaces. This form of noise can be very objectionable in residential areas, particularly late at night when background noise levels are at their lowest.

This paper details the attempts of a major quarry operator to reduce body rattle noise from the trailers of their vehicle fleet. Wimpey Environmental have carried out comparative noise tests during drive pasts of a vehicle which incorporated noise control measures and a standard unmodified vehicle. The results indicate that the measures undertaken have eliminated trailer body rattle noise. These findings have been included in a major noise study being carried out for the quarry operator as part of a formal Environmental Impact Assessment.

BACKGROUND

Hepworth Minerals and Chemicals Limited operate a major sand, working and processing operation at Chelford, Cheshire. Current output averages 1.0 million tonnes per annum. Planning permission is being sought to extend the reserves and production capacity. The mineral deposits at Chelford consist of a particularly high grade silica sand. Approximately half of the annual production is supplied to the glazing industry at three separate plant sites in St Helens, Merseyside. Deliveries are made in Hepworth Minerals and Chemicals own fleet of vehicles on a twenty-four hour basis.

In the early 1980's the local district council received a number of complaints from residents in the Knutsford area who were concerned about the level of noise and vibration from passing heavy goods vehicles late at night. Particular concern was expressed about noise from the chattering of trailer bodies of vehicles when passing over uneven or damaged sections of road. This led to a detailed traffic noise survey being undertaken in 1986 by the county highway authority.

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This noise survey revealed relatively high levels of noise from heavy goods vehicles passing through the nearby town of Knutsford during the night. Part of the problem was thought to be that during the early 1980's expenditure on highway maintenance in Cheshire had fallen back, resulting in a significant deterioration in general highway condition compared with the national average. Since 1986 expenditure on highway maintenance has increased. Furthermore, current procedures allow expenditure to be directed to improvements where work is required rather than operating on a rotational basis. This operational procedure is considered to have resulted in an improved state of the local road network in the Chelford and Knutsford area.

Following the 1986 survey, notwithstanding that there are other quarry and haulage firms operating in the area, Hepworth Minerals and Chemicals were keen to undertake positive steps to reduce noise emissions from their vehicle fleet.

VEHICLE MODIFICATIONS

The company operate a modern and well maintained fleet of vehicles. Standard ERF tractor units are used to haul bulk tipper trailers which are constructed from Mackworth aluminium bodies on AHP chassis. Gross vehicle weight is 38 tonnes with payloads averaging 25 tonnes. During the night-shift approximately fifteen vehicles are used for the delivery of glass sand to St Helens with each vehicle making four or five trips.

Noise levels from lorry tractor units have been reduced in EEC member states following a succession of Council Directives. These are summarised in Table 1. Considerable research has therefore been undertaken into the identification of sources of, and means of reducing, power train noise [1]. Body rattles, although identified as a source of vehicle noise [2], appear to have received little attention.

Table 1: Reduced EC Noise Limits For Goods Vehicles in dB(A)

GOODS VEHICLES (>3.5t)	EC DIRECTIVES: 84/424	77/212	70/157
< 100 HP	81		
100 - 200 HP	83	86	89
> 200 HP	84	88	91

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Trailer body noise emission levels will depend on a number of interrelated factors including:

(i) condition of the road surface;
(ii) quality of suspension system;
(iii) payload;
(iv) vehicle speed and driving style;
(v) tailgate and tipping pivot details;
(vi) damping of body panels.

Hepworth Minerals and Chemicals decided to focus attention on improving the suspension system and isolating metal to metal contact at key areas such as the tailgate and pivot points. The following modifications were carried out:

(i) conversion of the existing steel monoleaf suspension to an air suspension system;
(ii) fitting of a 'Hyva' body clamp which securely fixes the unladen trailer to the chassis;
(iii) bushing of tipping brackets and pivot pins;
(iv) provision of rubber isolators between the tailgate and the rear of the trailer.

NOISE TESTS

Comparative noise tests were carried out in the yard area at Chelford during drive-pasts of a modified and unmodified unladen trailer hauled by a standard ERF tractor unit. A precision sound level meter was used to measure maximum A-weighted sound pressure levels, L_{AMAX} and a separate graphic level recorder system was set up to provide a chart recording of each pass-by event. The microphones were fitted on to tripods at a height of 1.2 m and were located opposite a potholed section of road surface. vehicles passed within 6 - 7 metres of the noise monitoring position at a speed of approximately 35 mph. It was considered that at least ten pass-bys of each vehicle type would be required to establish the average L_{AMAX} values. However, it was found that the L_{AMAX} values of each pass-by event were remarkably consistent, with a standard deviation of under 1 dB(A), and therefore only four drive-pasts of each vehicle type were deemed to be necessary.

The results of the comparative noise tests in Table 2 show that the average maximum noise levels during pass-bys of the modified trailer were 10 dB(A) lower than during pass-bys of the unmodified vehicle.

Table 2: Results of Comparative Noise Tests

VEHICLE TYPE	L_{AMAX}	AVERAGE L_{AMAX}
UNMODIFIED TRAILER " " " " " "	97.3 dB(A) 96.7 dB(A) 96.6 dB(A) 97.8 dB(A) [SD = 0.5]	97.1 dB(A)
MODIFIED TRAILER " " " " " "	87.2 dB(A) 87.9 dB(A) 85.2 dB(A) 86.7 dB(A) [SD = 1.0]	86.8 dB(A)
AVERAGE NOISE REDUCTION		10.3 dB(A)

Subjectively, when driven over the pot-holed section of road a distinct clattering of the unmodified trailer body was noted. During the pass-by of the modified vehicle this clattering was absent and the noise event was limited to the power train noise of the tractor unit. The elimination of the maximum noise levels due to trailer rattles is clearly illustrated in Figure 1.

Environmental Health Officers from Cheshire County Council and Macclesfield Borough Council had been invited to attend the noise tests.

The Environmental Health Officers present agreed that noise emission from the trailer body had been successfully eliminated and that the 10 dB(A) reduction in drive-pass maximum noise levels represented a significant improvement. Subjectively, a reduction of 10 dB(A) is normally considered to equate to a halving of loudness.

CONCLUDING REMARKS

The additional costs of incorporating the modifications on to new trailers is approximately £2250 per vehicle, representing an increase in the cost of purchasing a new trailer of over 10 per cent. The cost of undertaking retrospective treatment of existing trailers is approximately £4250. There is also a marginal loss of payload capacity of some 200 kg.

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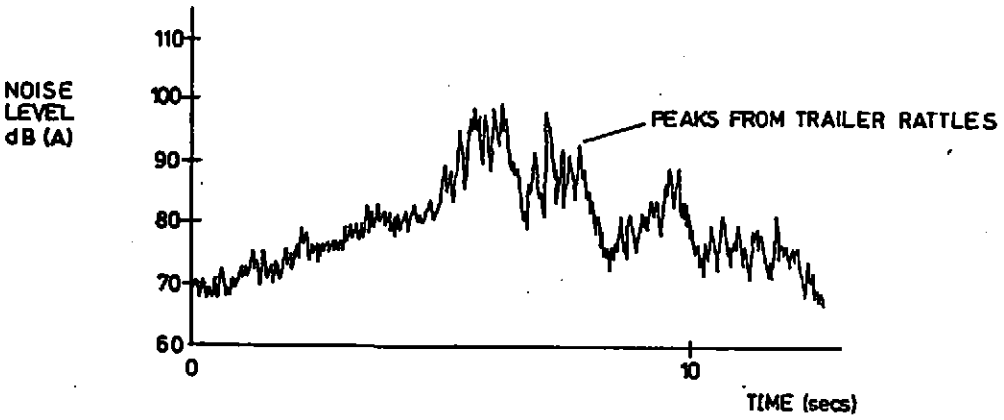
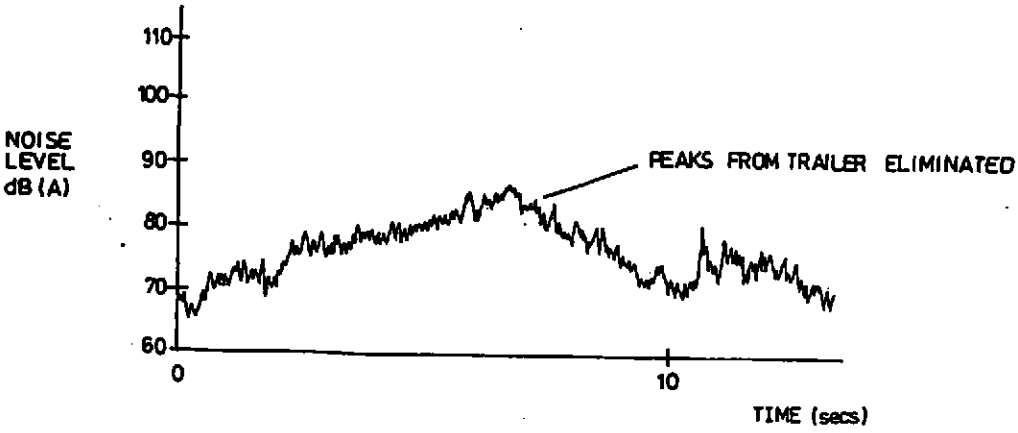
Figure 1: Examples of Chart Recordings

a) UNMODIFIED TRAILER



b) MODIFIED TRAILER



The company consider that the environmental benefits to local communities following the introduction of the noise control modifications outweigh the financial costs involved. All the trailers used for night deliveries of glass sand have now been fitted with the modifications. The county highway authority have received only one complaint regarding HGV traffic noise in the Knutsford area over the last five years.

The overall trend of stricter noise emission standards for road vehicles seems likely to continue. In the future as power train noise emissions are reduced regulations could emerge addressing the more esoteric problems of body rattles, brake squeal and low frequency noise. A standard procedure for stimulating body rattle already exists in Australia [4] in which vehicles are driven over a block of defined proportions. Those fleet operators who introduce noise control programmes now will be best placed to meet such regulations in the future.

REFERENCES

[1] Road Research Laboratory Report LR.375 (1970) "A Review of Road Traffic Noise"

[2] J W Tyler "Sources of Vehicle Noise" in P M Nelson (Ed) (1987) "Transportation Noise Reference Book" Butterworths & Co.

[3] B M Favre & J W Tyler "Quiet Vehicle Development" in P M Nelson (Ed) (1987) "Transportation Noise Reference Book" Butterworths & Co.

[4] Australian Standard 2240 (1979) "Methods of Measurement of the Sound Emitted by Motor Vehicles"