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NOISE IN DROP FORGE ANCILLARY WORK AREAS

M D CROKER

ISVR, SOUTHAMPTON UNIVERSITY

Introduction

Following the growing awareness of the drop forging industry to the social and financial consequences of industrial noise induced hearing loss there is a trend to isolate processes ancillary to drop forging from the stamp shop. With the isolation of such processes as bar cropping, coining, shotblasting and inspection comes the prospect of reducing the noise exposure of personnel operating these processes to levels below a 90 dB(A) Leq. The object of this paper is to present noise survey results from typical ancillary work areas, identify noise mechanisms and report on control measures currently being investigated. The work financed by the Department of Industry, is being carried out by ISVR in conjunction with the Drop Forging Research Association with the object of demonstrating feasible noise control techniques and costing such techniques.

Survey Methods and Findings

Three typical ancillary work areas have been visited, covering a range of forgings from 0.2kg to 25kg mass. The survey technique was based on tape recording, at the operator's position, the complete range of processes on a given site, using records of typically 1 to 5 minutes length, establishing a work pattern and constructing an estimated 8 hour 'A' weighted Leq for each operation. Results from these surveys are given in Table I. Only operations with 8 hour Leqs of 90 dB(A) or more are shown.

TABLE I

SITE	ACTIVITY	ESTIMATED 8 HR Leq dB(A)	TYPE OF NOISE	WORKERS EXPOSED
A	Tray tipping	91	H	1
	Shotblast	91	H	1
	Press Shop	91-96	H,M	6
	Inspection	92	H	10
B	Shotblast	95-106	H,M	1
	Heat treatment	93	H	2
	Saw shop (cropper)	90-99	F	5
	Grinding Shop	97-93	H	3
	Grinding Shop (press)	95	F	1
C	Saw shop (cropper)	90-97	F	5
	View room (hyd press)	92-102	H,M	3
	View room (press)	95	M	1
	View room	90-91	H	3
	Press Shop	91-100	F,M	1
	Shotblast	95	H	1
	Eng Dept (hyd press)	93	M	1
	Eng Dept (press)	91	F	1

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Workers exposed to: F = 13 where noise due to: F = workpiece fracture
M = 13 M = machine operation
H = 31 H = handling

Workpiece Fracture

Operations in this category are those where the fracture of the workpiece causes the main structural excitation and subsequent acoustic radiation eg. press noise increases if work is done on the workpiece. Machines such as bar croppers and cold clipping presses are in this category. The main feature which controls the acoustic emission is usually the rate of fall offof force with time at fracture. The steeper this unloading force/time gradient the greater the excitation at higher frequencies and consequently the machine is a more efficient radiator:- σ_{rad} and 'A' weighting effects. Experiments carried out at ISVR on a 20 ton crank press punching a 20mm dia hole in ¼" aluminium plate have shown that reducing penetration (which effectively reduces the force/time gradient) can reduce the punch event noise by 10 dB(A), Fig 1. Reducing the punch/die clearance also gives significant reductions - ∿ 10 dB(A) on reducing the diametral clearance from 10% to 2%, Fig 2.

fig1: fracture event noise v. punch penetration

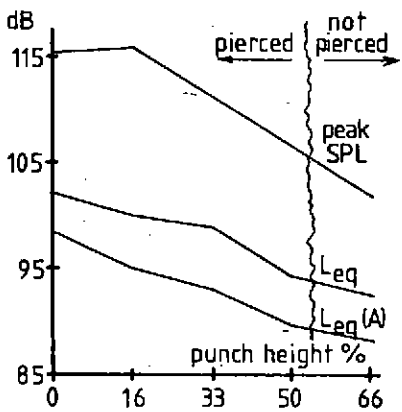
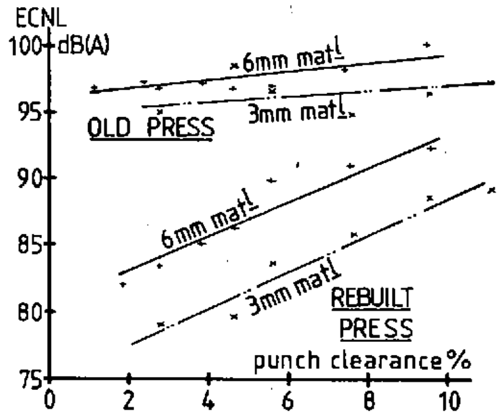


fig2: fracture event noise v. punch clearance



Machine Operation

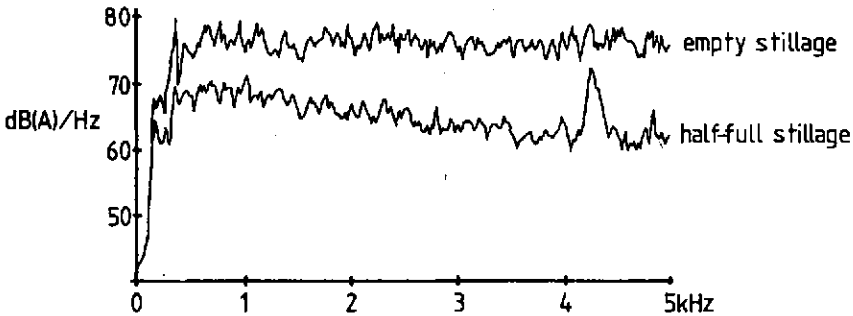
Operations where the presence or otherwise of the workpiece makes no difference to the noise output fall into this category. Wear in machinery can generally be categorised here, as can a whole host of design and operational acoustic mistakes. For example, a press guard which gave an equivalent continuous level of 94 dB(A), due to the lack of an effective resilient limit stop and completely dominated the operator Leq. Bearing impacts in a mechanism can completely transform the forcing function on a machine. Rebuilding the 20 ton crank press referred to earlier reduced the punching event Leq by 4 to 15 (depending upon tool clearance). It is apparent that machinery subject to rapidly fluctuating loads should be designed with small running clearances, adequate lubrication and a means of self compensation for wear in the bearings.

Handling Noise

The significant handling noise occurred where components were dropped, singly or en masse, into stillages (bins). Accepting that the forged components cannot be altered for acoustical reasons, either the component's kinetic energy at impact with the stillage must be reduced, or the stillage itself must be altered. A reduction in component kinetic energy of 2-3 dB could be achieved by raising the stillage off the floor, usually the operating personnel are standing. Alternatively, the component could be slowed by 'soft' impacts with a replacable 'impact plate'. Such systems are being investigated for use on shotblast unloading machines - the positioning and withdrawal of such plates being carried out by machinery associated with the loading/unloading mechanism of the shotblast

Stillage design is constrained by the need for the article to withstand red hot components, fork lift trucks, tempering oil and general abuse, at the same time as carrying the maximum payload per cubic metre of space taken up and costing the bare minimum. Hope that stillage redesign would prove effective was given in results from one firm visited where two trays of identical components were tipped sequentially into the same stillage. A reduction in Leq of 10 dB(A) was found for the second tipping, much more than would be expected from the reduction in average drop height (∿ 3 dB), Fig 3.

fig 3: sound spectra for stillage loading



It has since been confirmed that the stillage is generally the main acoustic radiator in the early stages of stillage filling. Fig 4 shows results from slow filling tests with 'standard' and experimental stillages of similar overall size. Fast filling tests gave a reduction from 108 dB(A) (at typical operator position) to 103 dB(A) for the unloading period Leq. Further work is being carried out.

fig 4 : slow loading test - 34 components / min

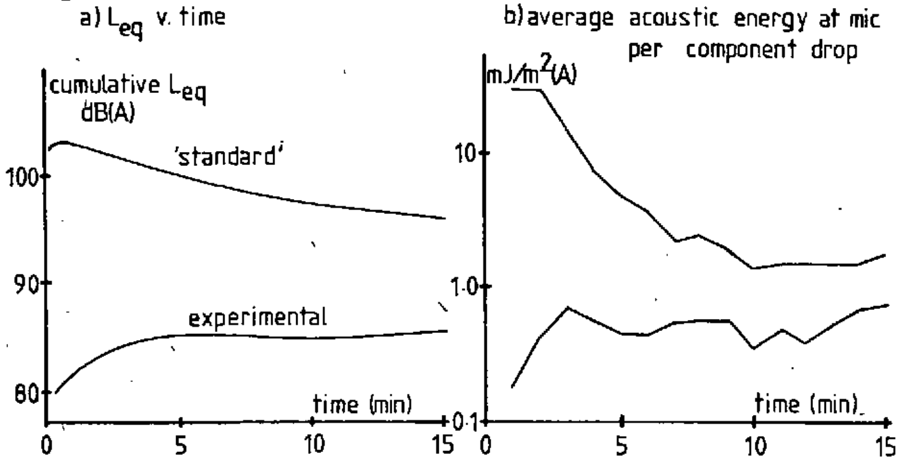


TABLE II

Position	Material	Energy (mJ/m^2, 'A' weighted) at mic				
		Clutch (1)	Fracture (2)	Cut Piece Drop (3)	Brake (4)	Total Cycle
Mic 1	80mm	1.6	7.8	-	5	22.0
"	75mm	5.2	12.7	-	4.6	28.0
"	50mm	4.3	0.4	4.7	4.3	18.5
Mic 2	80mm	6.0	18.2	60.0	6.0	107.0
"	75mm	22.0	17.6	4.4	9.9	59.4
"	50mm	14.4	6.4	57.6	16.0	106.6

Conclusion

A case study of a bar cropper is currently being carried out. An acoustic energy breakdown of the machine cycle is given in Table II for various material sizes. Thus event 3 comes into the handling category - an extension of the woven stillage design is hoped to be applicable here. Event 2 is in the workpiece fracture category, but on this machine stroke or cutter alteration is difficult.

Events 1 and 4 are caused by backlash impacts in the drive gear train (semi-exposed) exciting the flywheel and complete enclosure or heavy damping is likely to be the only economic solution, although if the material feed system were effective the machine need not be started and stopped for each cut.

To sum up, no insurmountable problems have been encountered, but most solutions require modification to existing practice or design and one can only hope that there is an increasing awareness amongst all designers of the acoustical requirement in new machinery, be it a £50,000 bar cropper or a £50 machine guard.