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A PROFILING DOSIMETRY STUDY OF A POLYTHENE MANUFACTURING PLANT

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I. INTRODUCTION

This study took place during the week beginning 15th May 1989 and included production, refinishing, maintainance and supervisory staff. During the week a detailed picture of noise exposure levels was built up using state of the art profiling dosimetry and computer analysis techniques. The results of the study, together with those of an earlier Noise Control Feasibility Study, were used by the company involved to formulate an Occupational Noise Management Scheme in line with the recommendations contained within this paper.

2. OBJECTIVES

As a result of measurements taken as part of the previous Noise Control Feasibility Study, areas of the plant were identified where noise levels approached or exceeded 90 dB(A). Such levels resulted in the possibility that employee noise exposure levels, expressed as dB(A) Leq (8hr), may exceed those defined as action levels by the H.S.E. Consultative Document ie: 85 dB(A) Leq (8hr) and 90 dB(A) Leq (8hr).

Following the above study it was recommended that direct measurement of employee noise exposure levels by dosimetry techniques should be under taken to enable a more precise identification of those at risk from noise induced hearing loss and to indicate the likely effectiveness of proposed noise control in reducing employee noise exposure levels. These were the objectives of the study described in this paper.

3. INSTRUMENTATION

Dosemeters used in this study were of the type refered to as 'profiling' or 'logging'. These instruments give an output of short term Leqs over a fixed time period, in this case every minute for 8 hours, as opposed to a single number readout from conventional non-profiling dosemeters. The noise at the microphone, which is worn close to the ear usually on a lapel or collar, is sampled several times during the minute to ensure the short term Leq is fully representative.

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Instrumentation details were as follows:

Six dB 3OI A Metrosonics profiling dosementers
Acoustic Calibrator for above instruments
IBM PC Twin Floppy Disk Drive Computer with associated software

Data manipulation was carried out using the IBM PC.The results were produced in graphical form as either Time History ie: the variation of noise level with time throughout the shift,or Amplitude Distribution ie: the percentage of time spent at a given noise level during the shift. This analysis was carried out on site.

4.METHOD

The following employee categories were monitored:

Machine Operators from No. I, 2, 3, 7, and I8/I9
Production Shift Foreman and Deputies
Stretch Wrapper,Printex Operator and Slitter
Electrical and Mechanical Maintainance
Scrap Clearance and Reclimation Operatives

A total of six production shifts were monitored,three different shifts over two days each.Copies of shift reports were obtained to enable correlation of noise levels with film formulation to be made.Data for other employee catagories was collected over two days except for the Slitter and Printex Operators where only one days data was obtained.

In all cases the means of deployment of the dosemeters was similar.On the first occasion the method of operation and format of results was explained to the employee who was then fitted with the dosemeter and requested to keep it on for the whole period of monitoring.On the second occasion the opportunity was taken to discuss the results from the previous day in order to correlate with working practices and identify any irregularities.Co-operation from all employees was of the highest order and abuses of the system minimal.

5.RESULTS

Sample results of the study are given at the end of this paper.The header information on each graph gives the employee name,location, date and time at which the monitoring began.The real time is then given along the bottom of the graph.

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The Time History graphs show the overall Leq for the period monitored in the top right hand corner.If the exposure pattern is representative of the short periods at the beginning and end of the eight hour production shift when the dosemeter was no worn this figure will be the same as the Leq (8hr). For shift periods other than eight hours corrections are required as discussed later.

Also given in the Time History header information are percentage dose and projected dose information based on the limits of 85 dB(A) Leq (8hr) and 90 dB(A) Leq (8hr). These represent the fraction of the noise dose recieved during the actual monitoring period or projected to an eight hour period eg: an exposure level of 93 dB(A) Leq (8hr) represents 200% of a 90 dB(A) Leq (8hr) dose.

The Amplitude Distribution graphs take the form of a histogram showing the percentage of the monitoring period during which given dB(A) levels were recorded.These levels increase in steps of I dB(A). The overall Leq is again given in the top right hand corner.This may differ slightly from the Time History Leq for the same data due to non-simultaneous sampling.The difference is minimal and is insignificant when interpreting the results.

Also given in the Amplitude Distribution header information are the statistical parameters $L_{0.1}$ to $L_{99.9}$. These represent the dB(A) level exceeded for the given percentage of the monitoring time eg: an L_{10} of 92 dB(A) means that a level of 92 dB(A) was exceeded for 10% of the shift.

In some cases data has been unavoidably corrupted either due to instrument mal functions or as a result of actions on the part of the wearer.Where this occurs the Leq (8hr) has been modified accordingly using the software features available.The vast majority of the data collected was,however, of a consistantly high quality.

Noise exposure levels measured for each employee catagory,with repeat readings,are summerised in Table I. Certain of these readings have been modified to delete the effect of spurious peaks or to rectify errors caused by instrument malfunctions as discussed above.Where this has been done the measured reading is given in brackets after the modified result.

In order to facilitate discussion of results,in particular the correlation of noise levels with operator location,spot readings were taken at selected positions.These baseline noise levels are given in Table 2.

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TABLE ONE

Employee Category	dB(A) Leq (8hr)	Average
Operator M/C No.1	93/92/93/92/93/94	93
Quality Control M/C No.1	93/94/93/91	93
Operator M/C No.2	92/90(88)/89/90	90
Quality Control M/C No.2	92/91	92
Operator M/C No.3	92/92/89/88(118)	90
Quality Control M/C No.3	89*/88*	89
Operator M/C No.18/19	91(92)/88/92/88(88)/90/89	90
Quality Control M/C No.18/19	87/90/90*/91*	90
Operator M/C No.7	90/86	88
Shift Foreman	85/86(89)/89/87/87/87	87
Printex Operator	82	82
Slitter	90	90
Stretch Wrapper	87/94(96)	91
Scrap Clearence	86/87	87
Reclimation	87(88)/85	86
Electrical Maintainance	92/90	91
Mechanical Maintainance	90/94	92

* deputy shift foreman

TABLE TWO

Measurement Position	dB(A)
Workstation M/C No.2/3	87
Front M/C No.2 during reel change	91
Rewinder M/C No.2	99
Rear M/C No.3	88
Granulator M/C No.3	91
Mezzanine over M/C No.2/3	89
Workstation M/C No.18/19	86
Front M/C No.18	85
Extruder M/C No.18	94
Granulator M/C No.18	97
Mess Room M/C No.18/19	66
Workstation M/C No.1	91

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6.DISCUSSION

Accumulated data is more numerous and therefore most representative for production shifts,a total of six shifts being monitored.Average Leq (8hr) fall within the range 88 - 93 dB(A) excluding the shift foreman whose Leq (8hr) everage is 87 dB(A). Individual graphs show clear peaks associated with reel change over and time spent in the rewinders,as well as troughs associated with break times or laboratory visits.Although noise levels vary with the film formulation the effect of this variation is not highly significant being no more than 2 dB(A) around the average. Consideration of each machine shows Leq (8hr) to be highest for No.I, at 93 dB(A),and lowest for No.7 at 88 dB(A).Other machines fall within the range 89 - 92 dB(A) and are similar for these machines.The results obtained for the Shift Foreman show greater variation in actual noise levels recorded,as would be expected,however,the Leq (8hr) are in them selves fairly consistant.

Based on the results the H.S.E. guidelines for the 1990 Regulations will require the compulsory wearing of hearing protection by operators of all machines excepting No.7 where protection is advisory only and should be made available.Shift Foremen would also fall into the advisory catagory. It has become accepted,and will remain so,that hearing protection should, whenever possible,be regarded as the last line of defence.There is an onus on employers to reduce noise levels resulting in exposures above 85 dB(A) Leq (8hr) whenever reasonably practical.In this case however the installation of close fitting acoustic enclosures to the machines would cause unacceptable production and maintainance problems and is therefore not an option.

Consideration has been given to the installation of sound havens around work stations to reduce operator noise exposure levels.Reference to the Amplitude Distributions together with Table 2 clearly shows that,in the majority of cases,greater than 50% of the total shift time is spent exposed to noise levels in excess of those at the work stations,Due to the greater energy content of the higher noise levels reductions of only I - 2 dB(A) would be achieved in practice.On this basis sound havens are not recommended as a method of reducing noise exposure levels of operators.The provision of sound havens may,however,be considered as benificial to eleviate the need for operators to wear hearing protection at all times.Should this be the case great care should be taken to ensure hearing protection is worn outside the havens.In this situation operators, especially those who use ear inserts which take time to fix.may be tempted not to use protection when venturing outside for short periods,such as to check or adjust the rewinders.This could result in an increase in their noise exposures.

Scrap Clearence and Reclimation employees show similar Leq (8hr) results at 87 and 86 dB(A) respectively and should be advised to wear hearing protection.The one shift of data obtained for the Printex Operator shows a noise exposure level below 85 dB(A) Leq (8hr) and there is therefore no reason to designate refinishing as a hearing protection area.A single shift of data obtained for the Slitter produced an Leq (8hr) of 90 dB(A) largely as a result of noise generated by machine No.7.It is recommended that consideration be given to relocating the Slitter to a quieter area, perhaps refinishing.Graphs for Electrical and Mechanical Maintainance show short periods of exposure associated with breakdown or overhaul of particular machines with less noisy periods in between.Since average noise exposure levels for both maintainance employees exceed 90 dB(A) Leq (8hr) it is recommended that the waering of hearing protection be made compulsory when working on machines,using hand power tools or when engaged in any other noisy operation.

The discussions and recomendations above are based on employees working eight hour shifts.The attitude of the H.S.E. to noise exposures for other than eight hours and particularly for complex shift patterns is not clearly established,and there is no provision in the draft regulations for assessing the later situation.Whilst some employees may work up to twelve hours on a voluntary overtime basis there is no specific requirement that this should be accounted for in calculating their noise exposure level.It is prudent,however,that this is done and as such 2 dB(A) should be added to their noise exposure level as stated.This increase does no effect the recommendations contained within this paper.

7.CONCLUSIONS

1.Noise exposure levels for machine operators currently exceed,or are likely to exceed,90 dB(A) Leq (8hr).

2.The provision of close fitting enclosures to reduce noise emitted by the machines would not be practical.

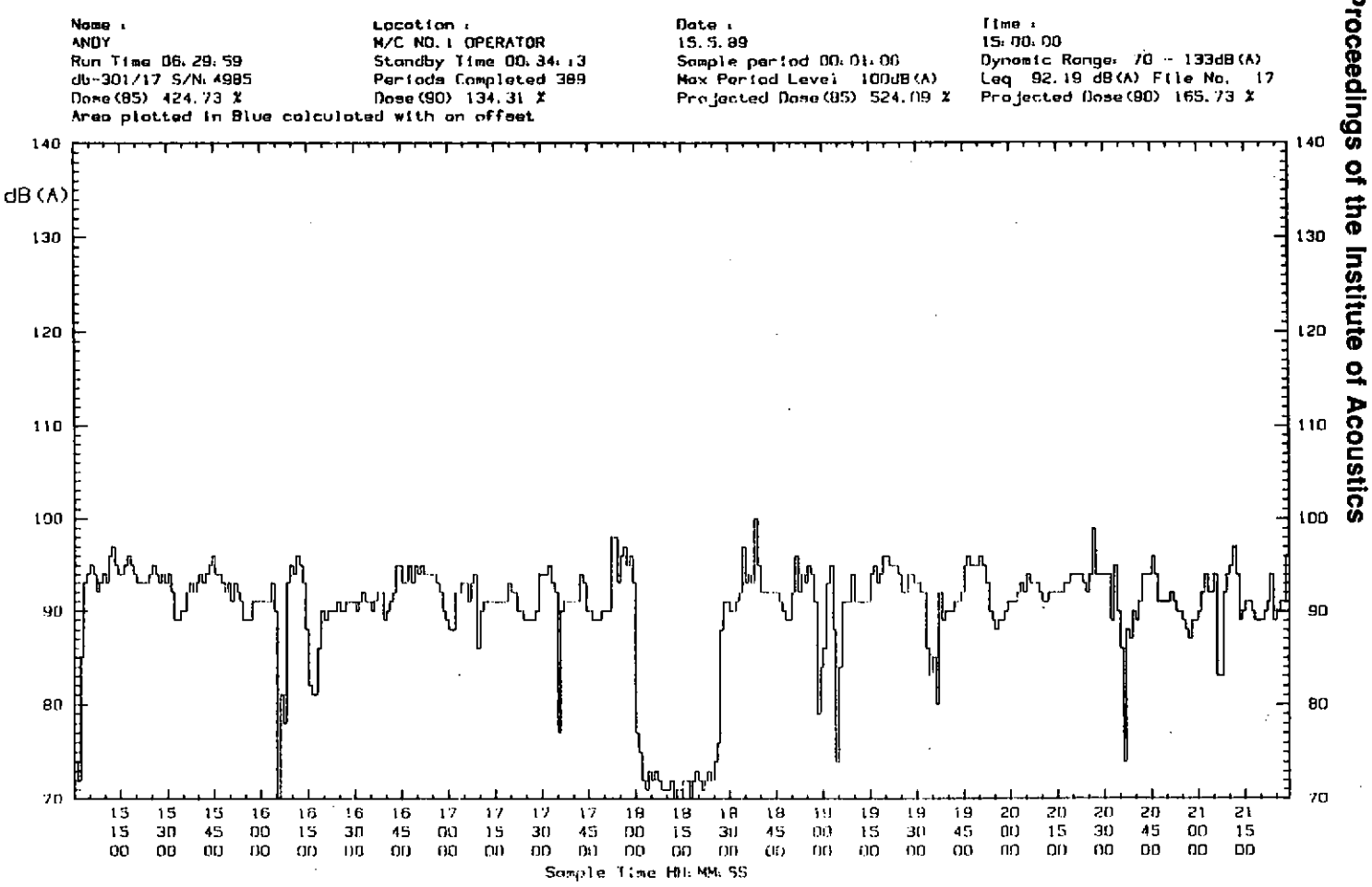
3.Sound havens around work stations are unlikely to reduce exposure levels by more than 1 or 2 dB(A).

4.The wearing of hearing protection should be made compulsory for all production shift personnel.

5.Employees carrying out duties associated with production shifts,such as scrap clearence and reclimation,should be advised to wear hearing protection.

6.The wearing of hearing protection by maintainance personnel should be made compulsory when working on,or inspecting,machinery,using hand power tools or carrying out any other noisy operation.

7.On the basis of limited results obtained in the refinishing area hearing protection does not appear to be required.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ANDY
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Dose(85) 424.73 %
Area plotted in Blue calculated with an offset
Location :
M/C NO. 1 OPERATOR
Standby Time 00:34:13
Periods Completed 389
Dose(90) 134.31 %
Date :
15.5.89
Sample period 00:01:00
Max Period Level 100dB(A)
Projected Dose(85) 524.09 %
Time :
15:00:00
Dynamic Range: 70 - 133dB(A)
Leq 92.19 dB(A) File No. 17
Projected Dose(90) 165.73 %
dB(A)
140
130
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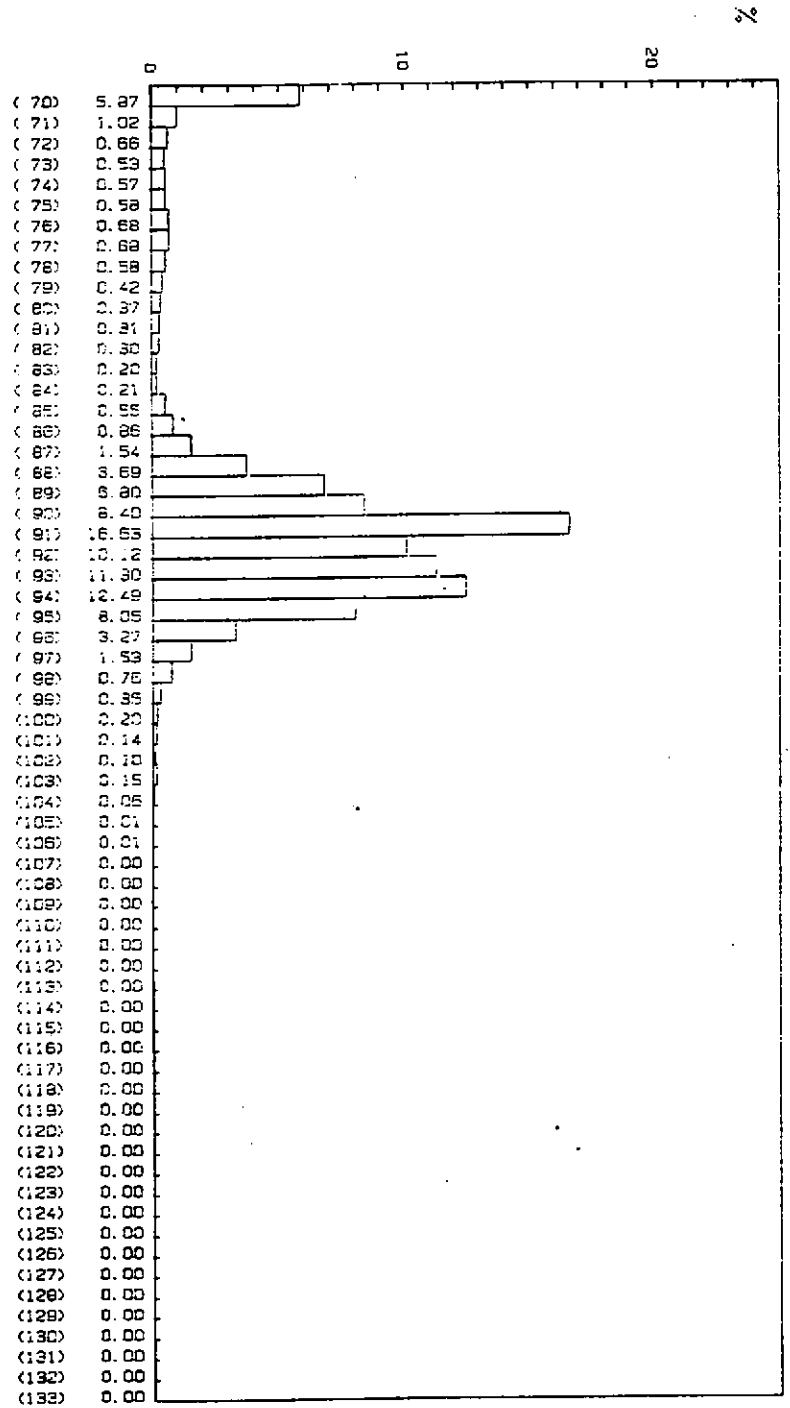
%
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10
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(71) 1.02
(72) 0.66
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(75) 0.58
(76) 0.68
(77) 0.68
(78) 0.58
(79) 0.42
(80) 0.37
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(82) 0.30
(83) 0.20
(84) 0.21
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(86) 0.86
(87) 1.54
(88) 3.69
(89) 6.80
(90) 8.40
(91) 16.65
(92) 10.16
(93) 11.30
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