

# Occupational exposure to MbOCA (4,4'-methylene-bis-ortho-chloroaniline) and isocyanates in polyurethane manufacture

Prepared by the **Health and Safety Laboratory**  
for the Health and Safety Executive 2010

# Occupational exposure to MbOCA (4,4'-methylene-bis-ortho-chloroaniline) and isocyanates in polyurethane manufacture

Chris Keen  
Matt Coldwell  
Kevin McNally  
Peter Baldwin  
John McAlinden

Health and Safety Laboratory  
Harpur Hill  
Buxton  
Derbyshire SK17 9JN

HSE has initiated workstrands that aim to deliver evidence that will help HSE to identify carcinogens of concern, to improve the control of carcinogens, and to provide a sound baseline for evaluating strategies for intervention. This project aimed to review the effectiveness of interventions (past and present) with respect to their impact upon the use of and exposure to carcinogens and carcinogenic processes - by providing up to date intelligence on levels of exposure control in the MbOCA (methylene-bis-ortho-chloro-aniline) user industry. During the period 2005/06 20 of the estimated 25 sites handling MbOCA were visited to record qualitative and quantitative measures of exposure control, and to take action on any deficiencies encountered. This project has revisited this industry in order to compare current data with previous exposure data. This will provide HSE with information on whether controls have improved since inspections took place during the 2005/06 period, and by updating HSE's baseline for assessing improvements in controls following future interventions. The study found that there have been no significant changes in MbOCA use and exposure control in the GB polyurethane industry since the HSE's 2005/6 intervention.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.

© Crown copyright 2010

First published 2010

You may reuse this information (not including logos) free of charge in any format or medium, under the terms of the Open Government Licence. To view the licence visit [www.nationalarchives.gov.uk/doc/open-government-licence/](http://www.nationalarchives.gov.uk/doc/open-government-licence/), write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email [psi@nationalarchives.gsi.gov.uk](mailto:psi@nationalarchives.gsi.gov.uk).

Some images and illustrations may not be owned by the Crown so cannot be reproduced without permission of the copyright owner. Enquiries should be sent to [copyright@hse.gsi.gov.uk](mailto:copyright@hse.gsi.gov.uk).

---

## **ACKNOWLEDGEMENTS**

HSE thanks the Polymers and Elastomers Group (PEG) within the British Rubber and Polyurethane Producers Association (BRPPA), particularly Dr Abid Dost and Martin Cooper, for their co-operation with this work. We also thank the companies and individuals therein who participated in this project. Thanks are also given to Dr John Cain and Priti Shah (HSE FOD Occupational Hygiene) and the staff of HSL's Analytical Sciences Unit, particularly Dr John Cocker, and Mathematical Sciences Unit, particularly Dr Nick Warren.

---

# CONTENTS

<b>1</b>	<b>INTRODUCTION</b> .....	<b>1</b>
1.1	Background .....	1
1.2	UK regulatory position .....	1
1.3	Overview of UK use .....	2
1.4	HSE intervention history .....	2
1.5	Scope of 2008 DRP survey .....	5
<b>2</b>	<b>METHODOLOGY</b> .....	<b>7</b>
2.1	Site selection .....	7
2.2	Visit protocol .....	7
2.3	Statistical analysis .....	9
<b>3</b>	<b>MAIN FINDINGS - 2008 DRP SURVEY</b> .....	<b>10</b>
3.1	Site visits .....	10
3.2	Data analysis .....	10
3.3	Biological monitoring.....	10
3.4	Air samples.....	12
3.5	Glove samples.....	12
3.6	Surface wipe samples.....	13
3.7	Exposure control.....	14
<b>4</b>	<b>COMPARISON OF 2005/06 SURVEY AND 2008 DRP SURVEY RESULTS</b> .....	<b>16</b>
4.1	MBOCA.....	16
4.2	Isocyanates .....	18
<b>5</b>	<b>DISCUSSION</b> .....	<b>20</b>
<b>6</b>	<b>CONCLUSIONS</b> .....	<b>23</b>
	<b>APPENDIX 1 - STATISTICAL ANALYSIS</b> .....	<b>25</b>
	Introduction.....	25
	Methodology .....	25
	Results .....	28
	Key Findings.....	61
	<b>APPENDIX 2 - SITE SUMMARIES</b> .....	<b>64</b>
	<b>APPENDIX 3 - STATEMENT ON OCCUPATIONAL CANCER FOR MBOCA (FROM HSE WEBSITE)</b> .....	<b>75</b>
	<b>REFERENCES</b> .....	<b>77</b>



# EXECUTIVE SUMMARY

## Objectives

This work was conducted as part of HSE's FIT3 Disease Reduction Programme (DRP) Cancer Project. The principal aim of the work was to provide feedback on the effectiveness of a HSE project conducted with the 4,4'-methylene-bis-(2-chloroaniline) (MbOCA) industry during 2005/6.

The stated objectives were :

i) To revisit the companies visited during the 2005/06 survey, plus any additional major users which have emerged since, and obtain data on:

- Levels of worker exposure to MbOCA (through biological monitoring)
- Levels of worker exposure to Isocyanates (through personal air sampling and biological monitoring)
- Levels of glove contamination (MbOCA)
- Levels of surface contamination around workplace (MbOCA)
- Standards of exposure control

ii) To analyse the above results and compare them where possible with those obtained during the 2005/6 intervention, in order to assess the effectiveness of that intervention.

iii) To update HSE's evidence base of use and control of exposure to MbOCA and report on any significant changes in MbOCA use since the 2005/6 intervention.

## Main Findings

MbOCA exposures in the polyurethane industry, measured by biological monitoring have not fallen between HSE's 2005/6 intervention and the 2008 DRP survey.

Data from HSL's biological monitoring database shows no discernible downward trend in urinary MbOCA levels since 1996. Between 1996 and 2008 the 90<sup>th</sup> percentile of urinary MbOCA data from HSL's biological monitoring database has remained around the range of 5 to 10  $\mu\text{mol/mol}$  creatinine, against a UK biological monitoring guidance value (BMGV) of 15  $\mu\text{mol/mol}$  creatinine.

The 2005/6 HSE survey of the MbOCA user industry provided a sound baseline on occupational exposures to MbOCA in Great Britain and was a valuable contribution towards ongoing intervention work. Industry criticisms of the feedback mechanisms and statistical data analysis from this work have been addressed by the 2008 DRP survey.

There have been no significant changes in MbOCA use and exposure control in the GB polyurethane industry since the HSE's 2005/6 intervention.

The 90<sup>th</sup> percentile of urinary MbOCA results for the 2008 DRP survey was 10 µmol/mol creatinine, however this value is not associated with good occupational hygiene practice in all cases. This study showed that there was scope for improvements in exposure controls and working practices at a number of the sites visited. A BMGV based on the data from this study and the 2005/6 survey would be below 15 µmol/mol creatinine, and furthermore would likely be less than 10 µmol/mol creatinine. The data from the 2008 DRP survey showed that 70 % of urinary values were below 5 µmol/mol creatinine.

Urinary MbOCA results above the BMGV occurred at 7 sites visited in the 2008 DRP survey. The dermal exposure route is most significant for MbOCA and exposure can be highly dependant upon individual working practices and relatively subtle differences in the way that exposure controls, especially gloves, are used.

Given the fairly small size of the MbOCA user industry in Great Britain, a small number of workers with elevated exposures are currently increasing some statistical summaries of MbOCA exposures in the industry. Reducing the MbOCA exposures of these individuals could be achieved by improved training and supervision, rather than implementation of additional engineering controls.

Although a minority of sites visited were achieving adequate exposure control for isocyanates, on an industry wide level it must be concluded that isocyanate exposures at MbOCA user sites in the polyurethane industry are not adequately controlled. Isocyanate results above the BMGV are common. Isocyanate exposures are not being reduced to as low as reasonably practicable (ALARP) in this industry.

The data from the 2008 DRP survey suggests that isocyanate exposures occur principally via the inhalation route. This should be considered when exposure control strategies for isocyanates are being reviewed. The use of low volatility, pre-polymeric isocyanate formulations, containing very low levels of isocyanate monomers, is standard practice across the industry. As far as possible isocyanates should be handled within the influence of Local Exhaust Ventilation (LEV). This was not done at a significant proportion of the sites visited. If the application of LEV is not practicable, respiratory protective equipment may be required.

As of December 2009, 11 of the 19 sites visited for the 2008 DRP survey have provided feedback indicating that they have taken action as a result of the recommendations made in the site visit reports.

## **Recommendations**

Further intervention activity by HSE, coupled with commitment from industry stakeholders, will be required to ensure that maximum impact is gained from the survey work described in this report.

Further investigation will be required to allow a clearer understanding of isocyanate exposure routes in the polyurethane industry. This would require the development of validated techniques for quantifying isocyanates on surfaces and on workers gloves.

















































































































































































