



End of year 1 Progress report 27/09/2010

**HSE Disease Reduction Programme**  
Programme of Work on Metal Working Fluids (MWF) &  
Respiratory Ill Health Associated with Exposure to Used MWFs

**Progress report: Year 1**

**Stage 1.1 Literature review: Outbreak investigations of respiratory disease in plants using**

**MWFs:** The report summarises twenty-nine relevant incident investigation reports and papers describing outbreaks of respiratory and skin disease, mainly in the United States. Due to a lack of published European studies, the review also summarises evidence gathered from European occupational health reporting schemes. The review highlights the diverse nature of the investigations even though many were carried out by one organisation (NIOSH carried out 23 of the 29). Differences include the methods used to identify and diagnose respiratory disease, in particular extrinsic allergic alveolitis (EAA), as well as the collection of data on exposure to chemical and microbiological agents in the MWF. Most of the studies concluded that microbial contamination of water based MWFs was the likely cause of EAA but no systematic investigation of chemical hazards in used MWFs was undertaken. Whilst *Mycobacterium sps* have been implicated as a causative factor for EAA in some US studies, their presence has not been recorded in many other studies and was not observed during the UK Powertrain investigation.

The reasons for lack of reported incident investigations in mainland Europe were not identified. Occupational health reporting networks identified some cases of respiratory disease attributed to work with MWFs and many more cases of dermatitis. Some European countries (e.g., Germany and Finland) reported much larger numbers of dermatitis cases, which may reflect the way that specific occupational diseases are investigated and reported (e.g., related to conditions for statutory declaration of occupational illness). Recent publications from Finland indicate that respiratory disease from MWFs is not unique to the US and UK.

**Stage 1.2 Clinical Case Definitions for EAA and Asthma caused by MWF:** This work involved a literature review of studies reporting case definition for EAA in those working with water based MWFs. Discussions were also held with the Group of Occupational Respiratory Disease Specialists (GORDS) to seek their views. The review concluded that many of the published case definitions are similar but none emerged as a 'gold' standard. Previously non-invasive criteria developed for the diagnosis of EAA have not been widely adopted and are not appropriate for use in the UK. There remains a need to develop a standardised approach to facilitate future outbreak investigations.

**Stage 1.3 Laboratory simulation of microbial contamination in conventional and bioconcept**

**MWFs:** This work involved laboratory tests to assess how contamination of water based MWFs impacted on the stability of the emulsion, the pH, and the growth of bacteria in these fluids. Conventional biocide containing MWF was compared with a Bioconcept fluid that contains no biocide and is formulated to permit growth of bacteria. The manufacturer of the Bioconcept fluids claims that the formulation encourages the growth of the 'lead' bacterium *Pseudomonas pseudoalcaligenes*, which out competes and prevents colonisation by more hazardous bacteria (e.g., *Pseudomonas aeruginosa*). Both types of fluids were tested under conditions simulating standard and poor management of the fluids.

In conventional MWF bacterial growth was inhibited for an extended period (>14 weeks) and after this significant bacterial colonisation occurred only in flasks of MWF contaminated with very high levels of tramp oil and swarf. These fluids were stable, and adjustments to pH and emulsion concentration were not required. The concentration of endotoxin remained very low and increased only in heavily contaminated conditions when bacterial growth commenced. By comparison, even 'well managed' bioconcept fluid required adjustment to pH and emulsion concentration. Under the



End of year 1 Progress report 27/09/2010

simulated 'poor management' large reductions in pH and emulsion concentration occurred more quickly and the lead bacteria was rapidly overgrown by *Pseudomonas aeruginosa*. This corresponded with an increase to very high levels of endotoxin.

The study demonstrated that a reduction in the alkalinity of bioconcept fluid was associated with growth of *P. aeruginosa* and a decline in viable *P. pseudoalcaligenes*. Lowering the alkalinity of poorly managed conventional MWF may also trigger growth of bacteria in these fluids. The results of these laboratory studies demonstrate that the management of 'bioconcept' fluids requires stringent standards (which the suppliers emphasise), that high levels of endotoxin are present and levels increase further when this fluid is less well managed. By comparison, biocide treated MWF is more stable, supporting bacterial growth and endotoxin production only when heavily contaminated

**Stage 1.4 Collection of data on the chemical constituents of MWFs and additives used to manage MWFs:** The objective for this work was to develop a database with a view to identifying those potentially hazardous to the human airway (i.e., irritants or chemical sensitising agents). At an early stage of this work the HSE Metalworking Forum consulted an independent expert (Paul Whitehead Chair of the UK Lubricants Association) who recommended that a wider consultation should take place before this work started. UKLA have agreed to nominate an expert to give a presentation to WATCH about hazard identification in used MWF.

**Stage 2.0 Planning for incident investigations of respiratory illness caused by MWFs:** The aim of this work was to bring together experts in hazard and health investigation to agree a process to investigate future outbreaks of respiratory disease caused by MWFs. This took into account HSE's regulatory duties alongside the need to manage the treatment of those with serious illness. A workshop on the 9th March 2009 was attended by HSE & HSL staff, UK industry representatives, clinical staff, and Dr Loren Tapp from NIOSH who has been involved in US investigations of ill health at plants using MWFs. The meeting participants identified different but conflicting needs that impact on an investigation of respiratory disease caused by MWFs; but they were unable to resolve a way forward. Consequently, the report recommends that a high level strategic steer is needed on priorities for investigating this type of incident before operational guidance can be produced. However, the report includes a draft for future development of an investigation protocol.

#### **Proposed work for Year 2 of the Programme:**

- Further work to explain the differences reported by different EU countries regarding the occurrence of skin and respiratory disease attributed to work with MWFs.
- Further work to develop agreed case definitions for EAA based upon a re-examination of the Powertrain dataset.
- Scoping international research into suitable methods to monitor mist from water mix metal working fluids.
- Further laboratory studies to examine the impact of pH in MWFs on the growth of bacteria in conventional, bioconcept and biostable MWFs.
- Investigation of portable equipment to monitor the stability of water based MWFs and contamination by microorganisms.