

# OCAPP/DHWM Laboratory Pollution Prevention Training Reference Guide

## ***DHWM Resources:***

Managing Hazardous Waste Generated in Laboratories, Ohio EPA, DHWM Fact Sheet, January 2005 at:

<http://www.epa.state.oh.us/dhwm/pdf/ManagingHazardousWasteFromLaboratories.pdf>

DHWM's reference list on Laboratories on web site:

<http://www.epa.state.oh.us/dhwm/guidancedocs.html#labs>

## ***OCAPP Resources:***

Research and Educational Laboratory Waste Reduction, 1997 OCAPP Fact Sheet

[http://www.epa.state.oh.us/opp/Fact16\\_web.pdf](http://www.epa.state.oh.us/opp/Fact16_web.pdf)

OCAPP reference list on web site:

<http://www.epa.state.oh.us/ocapp/sb/labrtory.html>

## ***U.S. EPA Resources:***

Environmental Management Guide for Small Laboratories, May 2000, 146 pages  
Developed by EPA to help the staff in small labs understand their responsibility for environmental management. It has P2 information throughout the manual.

<http://www.p2pays.org/ref/16/15829.pdf>

## ***Industry Resources:***

American Chemical Society (ACS)

<http://www.chemistry.org/portal/a/c/s/1/home.html>

**ACS Publication:** Less is Better Guide to Minimizing Waste in Laboratories, 9 pp,  
American Chemical Society, updated in 2002.

[http://membership.acs.org/c/ccs/pubs/less\\_is\\_better.pdf](http://membership.acs.org/c/ccs/pubs/less_is_better.pdf)

## **Alternative Chemicals/Substitutions**

University of Illinois @ Urbana-Champaign, Chemical Safety Section, a series of 12 Waste Min Fact Sheets and 5 fact sheets on Chem Waste. These address some alternative chemicals and P2 opportunities in labs at:

<http://www.ehs.uiuc.edu/css/factsheets/index.htm>

University of Wisconsin, LaCrosse, "82 Ways to Reduce Hazardous Waste in The Lab", Environmental Bulletin, contains some substitution suggestions at:

<http://www.uwlax.edu/ehs/labwaste.html>

University System of Georgia, Environmental Health & Safety, "100 Ways to Reduce Hazardous Waste in Labs" fact sheet at: <http://www.usg.edu/ehs/hot/reduce.phtml>

Sustainable Hospitals web site listing of alternative products for hospitals:

[http://www.sustainablehospitals.org/cgi-bin/DB\\_Index.cgi](http://www.sustainablehospitals.org/cgi-bin/DB_Index.cgi)

University of Illinois at Urbana-Champaign, Division of Research Safety, various fact sheets on lab waste minimization: <http://www.ehs.uiuc.edu/css/factsheets/index.htm>

Stanford University Environmental Health and Safety , lab product substitution opportunities found at: <http://www.stanford.edu/dept/EHS/prod/enviro/waste/index.html>

## **Inventory/Purchasing Controls Chemical Tracking Program Examples**

The Consolidated Hazardous Material Reutilization and Inventory Management Program (CHRIMP) or Hazardous Material Pharmacy is a logistical management system responsible for control of hazardous material inventories from requisition to disposal. The Navy and Airforce use this approach. CHRIMP or Pharmacy manages authorization, procurement, receipt, storage, issue, use, reuse/recycling and eventual disposal of hazardous materials and their containers. From the Joint Service Pollution Prevention Opportunity Handbook:

[http://p2library.nfesc.navy.mil/P2\\_Opportunity\\_Handbook/2\\_1\\_A\\_3.html](http://p2library.nfesc.navy.mil/P2_Opportunity_Handbook/2_1_A_3.html)

USAF Best Management Practices Hazardous Materials Pharmacy

<http://www.afcee.brooks.af.mil/eq/modelshop/bmp/index.asp?bmp=mp82>

University of Michigan:

[http://www.p2000.umich.edu/chemical\\_waste/cw2.htm](http://www.p2000.umich.edu/chemical_waste/cw2.htm)

Stanford University:

<http://www.stanford.edu/dept/EHS/prod/surpluschem/index.html>

Office of the Federal Environmental Executive, web page on Centralized Materials Management:

<http://www.ofee.gov/wpr/materialmgmt.htm>

Fort Bliss, TX, US Army Hazmart Case Study:

<http://aec.army.mil/usaec/support/p203.html>

University of Illinois @ Urbana-Champaign, Chemical Safety Section Fact Sheet on their Chemical Redistribution Program "Chem Cycle":

<http://www.ehs.uiuc.edu/css/factsheets/wm02.htm>

University of California San Diego, "Chem Cycle" program:

<http://chem-tech.ucsd.edu/Reuse/>

### **Materials Exchange Programs:**

Ohio Materials Exchange (OMEx)

<http://www.epa.state.oh.us/ocapp/p2/omex/omex.html>

Bowling Green State University's Orphan Chemical Recycling Program:

[http://www.bgsu.edu/offices/envhs/environmental\\_health/orphan\\_chemical/index.htm](http://www.bgsu.edu/offices/envhs/environmental_health/orphan_chemical/index.htm)

Materials Exchange and Reuse Programs in Ohio:

<http://www.epa.state.oh.us/ocapp/p2/omex/omexother.html>

### **Solvent Distillation**

#### **OCAPP Fact Sheet**

Solvent Distillation Fact Sheet #9 "On-Site Solvent Recycling Equipment"

<http://www.epa.state.oh.us/opp/solvents/fact9.pdf>

#### **Solvent Distillation Case Studies:**

Case study:

<http://www.zerowastenetwork.org/success/story.cfm?ID=577>

#### **Solvent Distillation Equipment Vendors:**

List maintained by OCAPP:

<http://www.epa.state.oh.us/opp/SolventRecycEquip.html>

## **Innovative Techniques**

### **Microscale Resources:**

National Microscale Chemistry Center's goal is to provide a network for the development of new microscale techniques, offer training courses in microscale chemistry, and introduce microscale methods throughout the science curriculum at all educational levels.: <http://www.microscale.org/who.asp>

### **Microscale Case Studies:**

Bemidji State University:

<http://mntap.umn.edu/intern/projects/BSU.htm>

STL, Inc Lab case Study, TX

<http://www.zerowastenetwork.org/success/story.cfm?ID=495>

University of Michigan: [http://www.p2000.umich.edu/chemical\\_waste/cw7.htm](http://www.p2000.umich.edu/chemical_waste/cw7.htm)

### **Video or Computer Simulation Demonstrations**

Chemistry Video Consortium Team at the School of Chemistry at University of Southampton, United Kingdom (UK). The activities were funded by the four Higher Education Bodies of the UK (1992-96) are geared towards a comprehensive set of instantly accessible video clips for use in laboratories, lectures and self-paced learning centers.

<http://www.chem.soton.ac.uk/cvc/>

Iowa State University, Chemistry Experiment Simulations, Tutorials and Conceptual Computer Animations for Introduction to College Chemistry. Some of the animations are designed to be used by chemistry instructors in presentations. These do not have directions or other information. Other animations are designed for students to use on their own or in group-work. Some of the animations and simulations have guided-inquiry tutorials to accompany them.

<http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/animationsindex.htm>

### **Alternative Methods vs. Wet Chemistry**

Direct Sensing Technologies being developed by Pacific Northwest Laboratory (PNL)

<http://availabletechnologies.pnl.gov/instmaterals/>

<http://www.technet.pnl.gov/sensors/chemical/projects/es4snssel.stm>

## **Green Chemistry**

The Green Chemistry Institute (GCI) is a non-profit organization within the American Chemical Society (ACS) that works across disciplines and academic, government, and industry sectors to promote the development and implementation of chemical products and processes that reduce or eliminate the use and generation of hazardous substances. More information is available at :

<http://www.chemistry.org/portal/a/c/s/1/acdisplay.html?DOC=greenchemistryinstitute\index.html>

US EPA Green Chemistry:

<http://www.epa.gov/greenchemistry/index.html>

### **Green Chemistry Case Studies:**

Bristol-Meyers Squibb:Development of a Green Synthesis for Taxol® Manufacture via Plant Cell Fermentation and Extraction

<http://www.epa.gov/greenchemistry/aspa04.html>

BHC Company Ibuprofen Process <http://www.epa.gov/greenchemistry/aspa97.html>

## **Schools and Universities/Colleges Resources:**

Environmental Virtual Campus: This project was undertaken by the Massachusetts Institute of Technology in connection with the settlement of an enforcement action brought by the United States Environmental Protection Agency and the United States Department of Justice for alleged violations of the Federal Clean Water Act, the Clean Air Act, and the Resource Conservation and Recovery Act.

<http://www.c2e2.org/evc/LabIndex.html>

Campus Consortium for Environmental Excellence

<http://www.c2e2.org/resources.htm>

USEPA Region 2:

<http://www.epa.gov/Region2/p2/univ.htm>

USEPA Healthy School Environment Chemical Use and Management

<http://cfpub.epa.gov/schools/index.cfm>

Lab Waste at Educational Institutions

<http://www.epa.gov/epaoswer/osw/specials/labwaste/index.html>

Project XL New England Universities Laboratories

<http://www.epa.gov/projectxl/nelabs/page6.htm>

US EPA Sector Programs-Colleges and Universities:

<http://www.epa.gov/sectors/colleges/index.html>

US EPA Enforcement Alert, July 2000, features “Universities and Colleges Not Receiving Top marks for Environmental Compliance” at:

<http://www.epa.gov/Compliance/resources/newsletters/civil/enfalert/universities.pdf>

US EPA Enforcement Alert, November 2004 features “Mismangement of Laboratory waste Creates Risk of Serious Injury” at:

<http://www.epa.gov/Compliance/resources/newsletters/civil/enfalert/labalert.pdf>

**Environmental Compliance and P2 Training Manual for Campus Based Organizations**, The New York State Department of Environmental Conservation's Pollution Prevention Unit and the State University of New York at Buffalo developed this manual which includes a summary of regulations, environmental compliance requirements, and pollution prevention methods for operational and facility maintenance personnel on campuses. At:

<http://www.dec.state.ny.us/website/ppu/ecppcamp.pdf>

### **Middle, and High School and College Science Teacher Resources:**

**Lab Waste and P2- A Guide for Teachers**, 1996 by Battelle Seattle Research Center, This guide explains how you can minimize the hazardous wastes and other undesirable by-products generated by experiments that are performed in classroom laboratories. It is intended for middle school, high school, and college science teachers. At:

<http://www.p2pays.org/ref/01/00779.htm>

European Centre for Chemistry Education: Various videos and CDROMs are available.

<http://www.soton.ac.uk/~ecchemed/conf.htm>

**Rehab the Lab Program** from the Local Hazardous Waste Management Program in King County, Washington State. This program has produced several references to assist high school teachers. A collection of fully-scripted, least-toxic chem labs ready for use by high school chemistry teachers can be down-loaded. The labs contain a teachers guide and student version. At:

<http://www.govlink.org/hazwaste/schoolyouth/rehab/>

### **Green Chemistry-Academia**

University of Oregon's database of lab experiments to illustrate green chemistry in undergraduate curriculum. <http://darkwing.uoregon.edu/~greenlab/index.html>

### **Sample P2 assessments/programs of college/university labs:**

Princeton University: <http://www.c2e2.org/robinscott.pdf>

University of New England : <http://www.une.edu/campus/ehs/hazard/initiatives.html>

University of Michigan P2 program: <http://www.p2000.umich.edu/index.html>

University of Pennsylvania audit: <http://dolphin.upenn.edu/~pennenv/audit/>

### **University/College Case Studies:**

University of Michigan:

<http://www.p2000.umich.edu/index.html>

<http://www.epa.gov/ispd/pdf/colleges.pdf>

Lawrence Berkeley National Laboratory

[http://www.lbl.gov/ehs/wastemin/goals/haz\\_priority.html](http://www.lbl.gov/ehs/wastemin/goals/haz_priority.html)

## **Hospitals**

Sustainable Hospitals web site:

[http://www.sustainablehospitals.org/cgi-bin/DB\\_Index.cgi?px=W](http://www.sustainablehospitals.org/cgi-bin/DB_Index.cgi?px=W)

Hospitals for a Healthy Environment: <http://www.h2e-online.org/index.cfm>

### **Hospital Case Study:**

[http://www.sustainablehospitals.org/cgi-bin/DB\\_Report.cgi?px=W&rpt=Subcat&id=18!21](http://www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Subcat&id=18!21)

## **Tools for Developing A P2 Program in a Lab**

City of Albuquerque, New Mexico document “**Analytical Laboratory Code of Practice**”. Contains information on putting together a team, a plan and tracking results.

Also contains vendor lists for cleaning supplies, distillation units, mercury and photographic service recyclers. Document is at: <http://www.cabq.gov/p2/pdfdownpg.html>

Step-By-Step Guide to Better Laboratory Management Practices, WA State Department of Ecology, Hazardous Waste Toxics Reduction program, January 2003, 106 pp.

<http://www.ecy.wa.gov/pubs/97431.pdf>

Checklist for Campus Compliance Success, December 2004, Kansas State University Pollution Prevention institute (PPI) at:

[http://www.sbeap.org/ppi/publications/Campus\\_Checklist.pdf](http://www.sbeap.org/ppi/publications/Campus_Checklist.pdf)

## **Training Opportunities**

North Carolina State University, Environmental Health and Safety 's On-Line training includes Laboratory Waste Training:

<http://www.ncsu.edu/ehs/www99/right/training/online.html>

College & University Hazardous Waste Conference

<http://www.cuhwc.org/>

Campus Safety and Health Environmental Management Association

<http://www.cshema.org>

## **Future Technologies**

NASA news release summarizing work done on "Lab-on-a-chip" technology. To make customized chips for various applications, NASA has an agreement with the U.S. Army's Microdevices and Microfabrication Laboratory at Redstone Arsenal in Huntsville, Ala, where NASA's Marshall Space Flight Center is located. The Marshall Center team is also collaborating with scientists at other NASA centers and at universities to develop custom chip designs for many applications, such as studying how fluidic systems work in spacecraft and identifying microbes in self-contained life support systems. News release at:

<http://www.nasa.gov/centers/marshall/multimedia/photos/2004/photos04-156.html>

Chemical and Engineering News journal article on Lab-on-a-chip technology :

<http://pubs.acs.org/cen/news/8214/8214notw3.html>

The National Nanotechnology Initiative (NNI) is a federal R&D program established to coordinate the multiagency efforts in nanoscale science, engineering, and technology. Twenty-two federal agencies participate in the Initiative.

<http://www.nano.gov/>

U.S. EPA website on nanotechnology, this site highlights EPA's research in nanotechnology and provides useful information on related research at EPA

<http://es.epa.gov/ncer/nano/index.html>

Abstract of US EPA funded nanotechnology project for environmental monitoring:

[http://cfpub.epa.gov/ncer\\_abstracts/index.cfm/fuseaction/display\\_abstractDetail/abstract/6348/report/0](http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display_abstractDetail/abstract/6348/report/0)

### **Other Helpful resources:**

LABS Central is being developed by the Department of Environmental Health and Safety at Iowa State University in Ames, Iowa. The LABS Central project is the result of a cooperative agreement between the US EPA Office of Solid Waste (OSW) and Iowa State. The goal of LABS Central is to provide access to existing web resources that potentially enhance the environmental performance of laboratories:

<http://www.labscentral.info/about.htm>

LabX.com was founded in 1995 to provide a forum where buyers and sellers of new, used, surplus, refurbished scientific, and laboratory equipment could find an item, negotiate the terms, and complete a purchase online. <http://www.labx.com/>