Technically Speaking

Meth Lab Chemicals

by John Nordin, PhD

Illegal laboratories that manufacture methamphetamines are one of the greatest challenges facing law enforcement officers. Unlike industrial chemical spills where the chemicals are labeled and Material Safety Data Sheets are readily available, the meth lab operations might typically take place in a house, corner of some building, motel, a trailer, or even inside a van or pickup truck. The chemicals will be contained inside various sized jugs or other containers, and probably unlabeled as to contents. The meth lab is a dangerous place; the lab could potentially be booby-trapped. Some of the chemicals may give off toxic gases if mixed or heated, and some chemicals can form explosive mixtures.

What Chemicals?

The PEAC tool user accessing "Lookup by: Meth Chemicals" will see a list of chemicals that might be found at a Meth lab. Some of the chemicals on the list are displayed below:

1-phenyl-2-propanone	desoxyfed	methyl benzene
2-Butanone	Destim	methyl ethyl ketone
2-Phenylacetic acid	diethyl ether	Methylamine
2-propanone	dimethyl ketone	Muriatic acid
acetone	Ephedrine	Natural gasoline
Alleract decongestant	Efedin	Novafed
alpha-toluic acid	ether	phenyl-2-propanone
aminomethane	ethyl ether	phenylacetic acid
Ammonia (anhydrous)	ethyl methyl ketone	phenylmethane
amphedroxyn	Fedin	red phosphorous
battery acid	hydrochloric acid	pseudoephedrine hydrochloride
benzeneacetic acid	iodine	safrole
Benzyl methyl ketone	light gasoline	Sinufed
biophedrin	lithium	sodium hydroxide
carbinol	lye	Sudafed
caustic soda	Maximum Strength Dristan	sulfuric acid
CoAdvil	methamphetamine	toluene
d-pseudoephedrine hydrochloride	Methamphetamine hydrochloride	wood alcohol
Desfedrin	methanol	wood naphtha
desoxyephedrin	methyl alcohol	

The PEAC tool display shows that many of these chemicals are very toxic or form explosive mixtures in air or reactive with water.

This list is not complete. This list includes many cold or decongestant remedies available as over-the-counter drugs plus chemicals available in hardware stores and places that supply paint and home supplies. Almost all of the listed chemicals have legitimate uses other than the manufacture of illegal drugs. Some of the listed chemicals are active ingredients in household products such as sodium hydroxide in sink drain cleaning products, methanol in gas-line deicers and in some paint-stripping products, sulfuric acid in lead storage batteries, hydrochloric acid as a scale remover, and paint thinners. Anhydrous ammonia is used as a fertilizer in farming operations. Hobbyists may use some of the chemicals in activities such as developing their own pictures in the dark room, electroplating metal surfaces, mineral identification, gold assay, cleaning antique metalwork or coins, synthesizing pheromones for taxonomic studies, insect survey traps using ethyl acetate or ammonia, restoring artwork, and stripping and refinishing woodwork. The possession of chemicals does not necessarily mean that illegal drugs are being manufactured.

Street Names

Street names for methamphetamine include "meth", "speed crank", "chalk", "go-fast", "zip", and "cristy". Street names for methamphetamine hydrochloride include "L.A.", "ice", "crystal", "64glass", and "quartz". Methamphetamine hydrochloride in its pure form (smokeable form of the drug) looks like clear, frozen water crystals; therefore the name "ice". More information on "ice" is at the website

http://www.w-dog.com/lice.htm. Yaba is a tablet containing a mixture of methamphetamine and caffeine. Other slang names are at the website, http://www.kci.org/meth_info/slang_names.htm

The approximate street value of the drug roughly $100 per gram, but this can vary depending upon the source of the drug and availability.

Mandatory Federal Minimum Sentences

The mandatory minimum sentences for methamphetamine trafficking under federal law is 5 years in prison for possession of 10 grams (pure basis) or 10 years in prison for 100 grams (pure basis) of methamphetamine. .

Manufacture of methamphetamines

The manufacture of methamphetamines is done by following a recipe; the recipe may be handwritten or available off the Internet. There are thousands of different recipes. A college chemistry degree is not required. The person

manufacturing the methamphetamine cooks the ingredients and is sometimes called the "cook". Cooks may hold classes to train other cooks. Several alternative methods are commonly used to manufacture methamphetamines.

- Ephedrine Method using red phosphorus. The starting chemical is ephedrine (or pseudoephedrine hydrochloride or d-pseudoephedrine hydrochloride). Pseudoephedrine (or its derivatives) is available as an active ingredient in Sudafed and certain other over-the-counter medicines. The chemical reaction is, **Ephedrine + hydroiodic acid + red phosphorous ------→ Methamphetamine** Hydroiodic acid (a controlled substance) is not purchased directly but is usually made from iodine. Both iodine and red phosphorous are available on the open market. Red phosphorous can also be obtained from wooden match heads through a series of processing steps. The ingredients are cooked forming the methamphetamine. Several steps are involved, including use of chemical reagents to separate the active ingredient from the inert ingredients in the purchased medicines, conversion of iodine to hydroiodic acid, and also to cook the ingredients. Solvents are used to separate the methamphetamine from the brew. Possible reagents that may be used include hydrochloric acid, sodium hydroxide (lye, or caustic soda), and sulfuric acid. Sodium chloride (table salt) and sodium thiosulfate are also used. Solvents could be acetone, ether, white gasoline, ethyl methyl ketone, toluene, etc., there are many choices. Methamphetamine hydrochloride crystals may be made by bubbling hydrogen chloride gas through the solvent containing the methamphetamine. The hydrogen chloride gas may be generated from mixing salt and battery acid or muratic acid and aluminum foil in a gas can connected to methamphetamine container with a hose.

- Ephedrine method by hydrogenation under pressure. This method is less commonly used because the process is even more dangerous. The starting material is still ephedrine (or pseudoephedrine hydrochloride or d-pseudoephedrine hydrochloride). The basic chemical reaction is **Ephedrine + Pressurized Hydrogen ---------→ Methamphetamine** The pressurized hydrogen comes from chemicals which react with water or other materials producing hydrogen; this is done in a closed vessel allowing the pressure to build up. Some reagents or chemicals that might be used in this process include (1) thionyl chloride, perchloric acid, or phosphorous pentachloride; (2) palladium black, sodium acetate, platinum, platinum chloride, or lithium aluminum hydride; and (3) sulfuric acid and lead battery material. Various solvents are used to extract and purify the

methamphetamine. Possible choices of solvents include methanol, ethanol, ether, acetic acid, and/or chloroform.

- Nazi Method. The cook starts by grinding up ephedrine or pseudoephedrine tablets (decongestion tablets purchased at the store). The powder is dissolved in a solvent (examples: acetone, toluene, isopropyl alcohol, methanol, ether, mineral spirits) making a milky liquid. The liquid is filtered (usually using a coffee filter) to remove the binders and other unwanted compounds; the filter containing the white sludge is discarded. The filtered liquid is placed in a pan or coffee pot or glass jar and evaporated (usually on a hot plate) leaving a white powder (purified ephedrine or pseudoephedrine). Small pieces of sodium or lithium metal are then mixed in with the container with the white powder. The lithium metal is probably obtained from lithium camera batteries that have been torn apart using pliers. The next step is to add anhydrous ammonia (often stolen from agriculture supply companies or from ammonia storage trailers in the field). The meth lab usually places the anhydrous ammonia into a five-gallon propane tank. The anhydrous ammonia is slowly dripped as a liquid into the mixture containing the lithium; the mixture turns dark blue to blackish purple in color. Once the powdered lithium has been dissolved, water is slowly added to the mixture to quench the reaction. The material is evaporated at room temperature leaving a thick, white paste called "meth oil". The "meth oil" is then dissolved in ether. One source of ether is from cans of starting fluid. The ether which contains the dissolved meth oil is place in a glass, mixed, and the bottom solids and water allowed to settle. The ether layer contains the dissolved methamphetamine. The methamphetamine is converted to crystals of methamphetamine hydrochloride (methamphetamine HCl) by bubbling hydrochloric acid into the glass container. Eventually the solution turns to a white paste. The remaining ether is filtered through a coffee filter. The methamphetamine HCl is collected on the filter and allowed to dry. Source: http://www.okienarc.org/nazilab.htm .

States have passed laws restricting the sale and possession of ephedrine and pseudoephedrine (with some exceptions), and have also restricted the amount of cold remedy tablets that may be purchased by individuals. Congress has passed the Methamphetamine Control Act of 1996 restricting key chemicals used to manufacture this drug, including reporting requirements for large purchases of iodine and red phosphorus. Recently, laws have been passed restricting the sale of anhydrous ammonia and the storage of anhydrous ammonia in non-authorized containers. One loophole which the federal government only recently is attempting to close is the use of the drug ephedra as the starting material. These can be purchased openly

in the form of tablets or capsules or powdered plant material in health food stores. Illegal drug manufacturers have also purchased the ephedra plant material itself in bulk form from Asian export companies. Ephedra reacts with hydroiodic acid and red phosphorous in much the same way as ephedrine to produce methamphetamine. Some additional compounds [d-amphetamine and d-N,N-dimethylamphetamine] are produced as the result of this process which contaminate the methamphetamine; these compounds represent markers which allow identification of confiscated methamphetamine as originating from ephedra. A possible recipe used by a clandestine laboratory might be to extract the active ingredients from the ground plant material using methanol, ether or other solvent. The methanol is evaporated producing a greenish-brown tar-like substance. The tar-like substance is reacted in a heated vessel fitted with a condenser with hydroiodic acid (iodine crystals, hydrochloric acid) and red phosphorus and cooked for several hours. The reaction mixture is cooled, filtered, and made basic with sodium hydroxide (lye, caustic soda); and then the methamphetamine is extracted with a suitable solvent.

Additional details on ephedra's role as a precursor for clandestine manufacture of methamphetamine is at the website, http://www.rhodium.ws/chemistry/ephedra.html.

Manufacture of Methamphetamine from Phenyl-2-Propane

This is an alternative method of manufacturing methamphetamine. Typically these labs will be in Mexico rather than the U.S. The chemical reaction is **Phenyl-2-Propanone + Methylamine -----** → **Methamphetamine.** There are several different recipes available, but they involve the starting materials phenyl-2-propanone, methylamine, various reagents, and various solvents. The reagent chemicals depend upon the recipe. One recipe calls for aluminum (as in aluminum foil or aluminum wire), mercuric chloride, and hydrochloric acid. Another uses hydrochloric acid, magnesium sulfate, and sodium hydroxide. Another uses sodium (hydrogen gas), copper sulfate, lime, and platinum oxide. Another method uses formic acid, hydrochloric acid, sodium hydroxide, and magnesium sulfate as reagents. Solvents could be methanol, ether, isopropyl alcohol, acetone, chloroform, ethanol, or benzene. The laboratory might also manufacture the phenyl-2-propanone and methylamine ingredients rather than purchase them. Phenyl-2-propanone can be manufactured from benzene and chloroactone using aluminum chloride as a reagent. Phenyl-2-propanone can also be manufactured from phenylacetic acid. There are also a series of chemical steps that can be used to manufacture phenylacetic acid. Possible chemicals used as starting materials are toluene, chlorine (can be produced from electrolysis of salt water or from sodium hypochloride),

sodium metal, sodium or potassium cyanide, ethyl acetate, or acetamiide. Methylamine can be manufactured from methanol and anhydrous ammonia. The meth lab can be a sophisticated operation using many hazardous chemicals. .

Designer Drugs

Various designer drugs may be manufactured by clandestine laboratories. These affect the central nervous system in a way analogous to methamphetamine, but may have different effects. The two common examples are 3,4-methylenedioxyamphetamine (MDA) and 3,4-methylenedioxymethamphetamine (MDMA), known by the street name "ecstasy". Another drug is Lysergic acid diethylamide (LSD). A fairly technical description on the manufacture of MDA, MDMA, and its analogs is presented in a 1990 paper by T.A. Dal Cason in *Journal of Forensic Science* volume 35(3) pages 675-697, available on the internet at http://www.rhodium.ws/chemistry/mda.dalcason.html.

MDA or MDMA require the use of certain precursor chemicals in their manufacture, in particular, safrole or isosafrole. The purchase or possession of these chemicals may be a tip off that MDA or MDMA is being manufactured. Other precursor chemicals may be piperonylacetone or piperonal and nitroethane. Safrole can be reacted with hydrobromic acid to produce MDA or MDMA. Isosafrole can be reacted with sodium dichromate to produce piperonal. Piperonal can be reacted with nitroethane to produce MDA or MDMA. Various reagents and solvents also play a role in the reaction chemistry. Possible chemicals at the MDA or MDMA facility (besides safrole or isosafrole) may be acetic acid, ammonium formate, formic acid, hydrochloric acid, hydrogen peroxide, sulfuric acid, lithium aluminum hydride, sodium dichromate, sodium borohydride, cuprous oxide, sodium carbonate, sodium hydroxide, mercuric chloride, hydrobromic acid, and (in one method) methyl amine. Solvents may include ether, ethanol, methanol, benzene, toluene, or acetone. Not all of the chemicals are required as there are different routes to producing MDMA and MDA, and also, "cooks" may use various substitute chemicals.

How Does Methamphetamine Work on the Human Body?

Methamphetamine works directly on the brain and spinal cord by interfering with the neurotransmitter dopamine. Dopamine is produced by the human body; it results in a person "feeling good", a feeling of euphoria and increased alertness, and a perceived heightened physical performance. Snorting produces effects within three to five minutes, and ingesting orally produces effects within 15 to 20 minutes. After several hours in this state

the user feels depression and desires additional drug to maintain his/her "high". Methamphetamine has a high potential for abuse and dependence.

Toxic effects can occur at a 50-milligram dose for a non-tolerant user. Repeat users may build up a tolerance to the drug requiring greater amounts to produced the desired "high" and some users may build up resistance to some of the toxic effects. The amount of methamphetamine in a street drug varies and is probably unknown to the user. Symptoms of toxic effects include athetosis (jerky movements, tremors), irritability, extreme nervousness, pupil dilation, dizziness, sweating, insomnia, confusion, incessant talking, hyperthermia (increase in body temperature), and convulsions. The increase in body temperature coupled with increased physical activity can result in death; in extreme cases, the body temperature can rise to as much as 108^{o}F. Other toxic effects may include chest pain and hypertension, which can result in irreversible damage to blood vessels in the brain and/or cardiovascular collapse and death.

Long-term toxic effects with repeat users may result in conditions resembling schizophrenia (aggressive behavior, panic, paranoia, hallucinations, repetitive behavior patterns, and homicidal or suicidal thoughts). Damage to the kidneys, lungs, brain, and liver may result from long-term use, enough to be fatal. Blood clots may occur in the brain.

Withdrawal symptoms include, drug craving, loss of energy, depression, extreme irritability, excessive drowsiness or difficulty in sleeping, shaking, nausea, heart palpitations, and sweating. Some of the acute withdrawal symptoms last for a few days. Other effects such as extreme irritability last much longer. The recovery or "wall" period may last 6 to 8 months for casual users and 2 or 3 years for regular users. Some people may never recover because of permanent brain damage.

In the United States, legitimate prescription use of methamphetamines is rare, and if prescribed, the dose is low (lower than in a typical street drug). Methamphetamine has been prescribed under the name Desoxyn for attention deficit disorder and for narcolepsy.

Clandestine meth laboratories do not maintain the rigorous control and testing pharmaceutical companies do when manufacturing drugs. The result is that the meth lab may unintentionally produce drugs containing toxic byproducts. Also the strength of the drug may be unknown to the user. An example of a toxic byproduct contaminating a street drug is 1-methyl-4-phenyl-1,2,5,6-tetrahydropyridine (MPTP). Taking MPTP results in death of brain cells and uncontrollable shaking. Chloropseudoephedrine can be produced during the ephedrine method. Other impurities can cause severe

and permanent neurological disability to the user, as well as injury to the liver, kidneys, brain, and respiratory system. .

Meth Labs are Dangerous Places

Many of the chemicals used at meth labs are flammable, toxic, and/or water reactive. Additional toxic and explosive chemicals can be produced on site. Many of the solvents form explosive mixtures in the air and are toxic by inhalation. Ether (a possible solvent used at a meth lab) can form dangerous peroxides on storage or if contaminated with certain metal salts which can detonate if even the container lid is opened. Acetone, acids, and hydrogen peroxide form explosive mixtures. The use of mercury salts may result in poisonous mercury vapor (or mercuric chloride vapor) to be given off. Overheating during the red phosphorous cooking step may result in production of the toxic gas phosphine. The toxic and deadly gas phosgene might be generated if thing go wrong at the meth lab, killing all present. Lithium or sodium reacts violently with water. More information can be found at the website, http://mfiles.org/.

Because of the dangers, the Occupational Safety and Health Administration as mandated that police officers and responders receive training and wear special equipment before entering a situation involving a clandestine laboratory.

The Prescott Valley Tribune carried an article about a couple who unknowingly purchased a home that had formally been used to manufacture methamphetamines (ephedrine method using red phosphorus), and later developed headaches and nausea and other health problems after they moved into their home. Details are at http://www.prescottaz.com/meth/house.htm.

Is There a Meth Lab in Your Neighborhood?

Information taken from: http://www.kci.org/meth_info/neighborhood_lab.htm.

Some signs that could indicate the presence of a meth lab operating in a neighborhood include the following:

- Unusual strong chemical odors (like cat urine, ether, fingernail polish, ammonia, acetone, or other chemicals)
- Residences with windows blacked out
- Renters who pay landlords in cash
- Lots of traffic, especially people coming and going at night

- Excessive trash containing items such as red-stained coffee filters, white-stained coffee filters, empty chemical containers, drain cleaner containers such as Drano or Red Devil Lye, punched starting fluid containers, mangled lithium batteries, cold tablet packaging, spent wooden matches, excessive duct tape, hoses, etc. These might be collected and disposed at highway rest stops.
- Unusual amounts of clear glass containers brought into the home

Summary

Let us recap the highlights. The two most common methods of manufacturing meth drugs are (1) ephedrine method using red phosphorus (also called "red phosphorus" or "Red P" method) and (2) Nazi method. Other methods require a much more elaborate setup, and are more likely to be done in Mexico or in a secluded warehouse rather than in a house or trailer. Both methods start with cold congestion tablets or possibly ephedra. Both use solvents to separate the desired raw starting chemical from the crushed pills. Solvents may be acetone, ether, methanol, etc., almost anything the meth lab can get their hands on; they are readily available at hardware stores. The solvent containing the dissolved starting chemical is filtered or decanted and evaporated. In the red phosphorous method, the evaporated residue is cooked for several hours with red phosphorous (usually obtained from match heads), iodine (usually sold as a disinfectant), and hydrochloric acid (available from hardware stores). The cooled material is then neutralized and filtered (usually using a coffee filter). The meth is extracted using a solvent. In the Nazi method, lithium metal (usually obtained from lithium batteries) is mixed with the residue after solvent evaporation and anhydrous ammonia (probably stolen from an agriculture supply facility) added without heating. Water is added after the reaction is complete and the material is filtered. The meth is extracted from the filtered paste-like material using a solvent. The hydrogen chloride form of the methamphetamine is created by bubbling hydrogen chloride into the solvent containing the methamphetamine. The solvent is evaporated. The various solvents and anhydrous ammonia produce odors, and prolonged inhalation of the vapors and gases produce serious health problems.

Trash left by meth labs might include: red-stained coffee filters from red phosphorous method, white or off-white material in coffee filters, empty solvent containers, hoses or tubing, mangled lithium batteries (Nazi method), duct tape, and many wooden match sticks. While a couple of cold remedy tablet packaging in trash might indicate a bad cold, many such packages especially in combination with other trash indicators almost certainly mean that a meth lab has been operating.

Many of the chemicals used form explosive mixtures.

The final street drug could potentially be contaminated with dangerous chemicals and could potentially cause death or severe brain injury.

More Reading

- American Council for Drug Education http://www.acde.org/
- Community Action Group (CAT) http://www.meooow.org/
- Cornerstone Behavioral Health http://www.Cornerstonebh.com/pubs.htm
- Emedicine.com (emergency medicine) http://www.emedicine.com/EMERG/topic859.htm
- Indian Minority Student Development (IMSD) program through American Indian Research Opportunities (AIRO), a Montana State University-Bozeman Department http://www.montana.edu/wwwai/imsd/rezmeth/mainpage.htm
- Indiana University-Purdue University Indianapolis School of Science http://www.science.iupui.edu/SAC98/team6.htm
- Iowa Health System http://www.nursessource.com/
- Kansas Department of Health & Environment http://www.kdhe.state.ks.us/methlabs
- Koch Crime Institute http://www.kci.org/meth_info/Crank_Babies/index.htm , http://www.kci.org/meth_info/neighborhood_lab.htm ,
- Missouri http://www.dnr.state.mo.us/magazine/2001_spring/Risky_Business_Feature.htm
- National Drug Intelligence Center Illinois Drug Threat Assessment http://www.usdoj.gov/ndic/pubs/652/meth.htm
- National Institute on Drug Abuse (NIDA) http://www.drugabuse.gov/DrugPages/ , http://www.drugabuse.gov/MethAlert/MethAlert.html , http://www.drugabuse.gov/ResearchReports/methamph/methamph.htmll, http://www.clubdrugs.org/
- National Youth Anti-Drug Media Campaign http://www.theantidrug.com/
- Northwest High Intensity Drug Trafficking Area (HIDTA) http://www.mfiles.org/, http://www.mfiles.org/Meth/overview/qr_frequently_asked_questions.htm
- Oklahoma Department of Environmental Quality http://www.deq.state.ok.us/
- Streetdrugs.org http://www.streetdrugs.org/
- Substance Abuse & Mental Health Services Administration http://www.samhsa.gov/

- Topeka Capital-Journal http://www.cjonline.com/stories/051501/kan_metheffort.shtml
- U.S. Drug Enforcement Agency (DEA) http://www.usdoj.gov/dea/concern/concern.htm
- Washington State Dept. of Health, Guidelines for Contamination Reduction and Sampling at Illegal Drug Manufacturing Sites. http://www.doh.wa.gov/ehp/ts/CDL/CDLGuidelines.pdf
- A good detailed article: http://www.geocities.com/beyondbadge/drugs/Mlabs.htm#precursor.