

IX. APPENDIX I

SAMPLING AND ANALYTICAL METHOD FOR CRESOL

This method for sampling and analysis is adopted from NIOSH Method No. S167 [40].

Principle of the Method

(a) A known volume of air is drawn through a silica gel tube to trap the organic vapors present.

(b) The silica gel in the tube is transferred to a small, stoppered sample container, and the analyte is desorbed with acetone.

(c) An aliquot of the desorbed sample is injected into a gas chromatograph.

(d) The combined areas of the resulting two peaks are determined and compared with areas obtained for standards.

Range and Sensitivity

(a) This method was validated over the range of 10.54-42.2 mg/cu m at an atmospheric temperature and pressure of 22 C and 760 mmHg, using a 20-liter sample. Under the conditions of sample size (20 liters), the probable useful range of this method is 5-60 mg/cu m at a detector sensitivity that gives nearly full deflection on the strip chart recorder for a 1-mg sample. The method is capable of measuring much smaller amounts if the desorption efficiency is adequate. Desorption efficiency must be

determined over the range used.

(b) The upper limit of the range of the method is dependent on the adsorptive capacity of the silica gel tube. This capacity varies with the concentrations of the analyte and other substances in the air. The first section of the silica gel tube was found to hold at least 1.87 mg of analyte when a test atmosphere containing 42.2 mg/cu m of analyte in air was sampled at 0.185 liter/minute for 240 minutes. (The silica gel tube consists of two sections of silica gel separated by a section of urethane foam.) If a particular atmosphere is suspected of containing a large amount of contaminant, a smaller sampling volume should be taken.

Interferences

(a) Silica gel has a high affinity for water, so organic vapors will not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.

(b) When compounds other than the isomers of cresol are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. Since acetone is used to desorb the analyte from the silica gel, it is not possible to measure acetone in the sample.

(c) It must be emphasized that any compound which has the same retention time as the analyte at the operating conditions described in this method is an interference. Retention time data on a single column cannot be considered proof of chemical identity.

(d) If the possibility of interference exists, separation conditions (column packing, temperature, etc.) must be changed to circumvent the problem.

Precision and Accuracy

(a) The Coefficient of Variation for the total analytical and sampling method in the range of 10.54-42.2 mg/cu m was 0.068. This value corresponds to a 1.5 mg/cu m standard deviation at the OSHA standard level.

(b) On the average, the concentrations obtained at the OSHA standard level using the overall sampling and analytical method were 4.2% lower than the "true" concentrations for a limited number of laboratory experiments. Any difference between the "found" and "true" concentrations may not represent a bias in the sampling and analytical method, but rather a random variation from the experimentally determined "true" concentration. Therefore, no recovery correction should be applied to the final result.

Advantages and Disadvantages of the Method

(a) The sampling device is small, portable, and involves no liquids. Interferences are minimal, and most of those which do occur can be eliminated by altering chromatographic conditions. The tubes are analyzed by means of a quick, instrumental method. The method can also be used for the simultaneous analysis of two or more substances suspected to be present in the same sample by simply changing gas chromatographic conditions from isothermal to a temperature-programmed mode of operation.

(b) One disadvantage of the method is that the amount of sample that can be taken is limited by the number of milligrams that the tube will hold before overloading. When the sample value obtained for the backup section of the silica gel tube exceeds 25% of that found on the front section, the possibility of sample loss exists.

(c) Furthermore, the precision of the method is limited by the reproducibility of the pressure drop across the tubes. This drop will affect the flowrate and cause the volume to be imprecise, because the pump is usually calibrated for one tube only.

Apparatus

(a) A calibrated personal sampling pump whose flow can be determined within $\pm 5\%$ at the recommended flowrate.

(b) Silica gel tubes: glass tube with both ends flame sealed, 7 cm long with a 6-mm OD and a 4-mm ID, containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel, the backup section, approximately 75 mg. A 3-mm portion of urethane foam is placed between the outlet end of the tube and the backup section. A plug of silylated glass wool is placed in front of the adsorbing section. The pressure drop across the tube must be less than 1 inch of mercury at a flowrate of 1 liter/minute.

(c) Gas chromatograph equipped with a flame ionization detector.

(d) Column (10-ft x 1/8-in stainless steel) packed with 10% FFAP in 80/100 mesh, acid washed DMCS Chromosorb W.

(e) An electronic integrator or some other suitable method for measuring peak areas.

(f) Two-milliliter sample containers with glass stoppers or Teflon-lined caps. If an automatic sample injector is used, the associated vials may be used.

(g) Microliter syringes: 10 μ l and other convenient sizes for making standards.

(h) Pipets: 1.0-ml delivery pipets.

(i) Volumetric flasks: convenient sizes for making standard solutions.

Reagents

(a) Chromatographic quality acetone.

(b) Cresol (all isomers): Prepare a standard mixture of the isomers by adding together 20 g of the ortho, 40 g of the meta, and 30 g of the para isomers and mix.

(c) Prepurified hydrogen.

(d) Filtered compressed air.

(e) Purified nitrogen.

(f) n-Hexane, reagent grade.

Procedure

(a) Cleaning of Equipment. All glassware used for the laboratory analysis should be detergent washed and thoroughly rinsed with tapwater and distilled water.

(b) Calibration of Personal Pumps. Each personal pump must be calibrated with a representative silica gel tube in the line. This will minimize errors associated with uncertainties in the sample volume collected.

(c) Collection and Shipping of Samples

(1) Immediately before sampling, break the ends of the tube to provide an opening at least one-half the internal diameter of the tube (2 mm).

(2) The smaller section of silica gel is used as a backup and should be positioned nearest the sampling pump.

(3) The silica gel tube should be placed in a vertical direction during sampling to minimize channeling through the silica gel.

(4) Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

(5) A sample size of 20 liters is recommended. Sample at a flow of 0.20 liter/minute or less. The flowrate should be known with an accuracy of at least $\pm 5\%$.

(6) The temperature and pressure of the atmosphere being sampled should be recorded. If pressure reading is not available, record the elevation.

(7) The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Under no circumstances should rubber caps be used.

(8) One tube should be handled in the same manner as the sample tube (break, seal, and transport), except that no air is sampled through this tube. This tube should be labeled as a blank.

(9) Capped tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

(10) A sample of the bulk material should be submitted to the laboratory in a glass container with a Teflon-lined cap. This sample should not be transported in the same container as the silica gel tubes.

(d) Analysis of Samples

(1) Preparation of Samples. In preparation for analysis, each silica gel tube is scored with a file in front of the first section of silica gel and broken open. The glass wool and the silica gel in the first (larger) section are transferred to a 2-ml stoppered sample container. The separating section of foam is removed and discarded; the second section is transferred to another stoppered container. These two sections are analyzed separately.

(2) Desorption of Samples. Prior to analysis, 1.0 ml of acetone is pipetted into each sample container. Desorption should be done for 30 minutes. Tests indicate that this is adequate if the sample is agitated occasionally during this period. If an automatic sample injector is used, the sample vials should be capped as soon as the solvent is added to minimize volatilization.

(3) GC Conditions. The typical operating conditions for the gas chromatograph are:

50 ml/min (60 psig) nitrogen carrier gas flow

65 ml/min (24 psig) hydrogen gas flow to detector

500 ml/min (50 psig) airflow to detector

230 C injector temperature

250 C manifold temperature (detector)

200 C column temperature

(4) Injection. The first step in the analysis is the injection of the sample into the gas chromatograph. To eliminate difficulties arising from blowback or distillation within the syringe needle, one should employ the solvent flush injection technique. The 10- μ l syringe is first flushed with solvent several times to wet the barrel and plunger. Then 3 μ l of solvent are drawn into the syringe to increase the accuracy and reproducibility of the injected sample volume. The needle is removed from the solvent, and the plunger is pulled back about 0.2 μ l to separate the solvent flush from the sample with a pocket of air to be used as a marker. The needle is then immersed in the sample, and a 5- μ l aliquot is withdrawn, taking into consideration the volume of the needle, since the sample in the needle will be completely injected. After the needle is removed from the sample and prior to injection, the plunger is pulled back 1.2 μ l to minimize evaporation of the sample from the tip of the needle. Observe that the sample occupies 4.9-5.0 μ l in the barrel of the syringe. Duplicate injections of each sample and standard should be made. No more than a 3% difference in area is to be expected. An automatic sample injector can be used if it is shown to give reproducibility at least as good as the solvent flush method.

(5) Measurement of area. Although there are three isomers of cresol, there are only two peaks on the gas chromatogram, because the meta and para isomers have the same retention time. The total area of the two sample peaks is measured by an electronic integrator or some other suitable form of area measurement, and preliminary results are read from a standard curve prepared as discussed below.

(e) Determination of Desorption Efficiency

(1) Importance of determination. The desorption efficiency of a particular compound can vary from one laboratory to another and also from one batch of silica gel to another. Thus, it is necessary to determine, at least once, the percentage of the specific compound that is removed in the desorption process, provided the same batch of silica gel is used.

(2) Procedure for determining desorption efficiency. Silica gel equivalent to the amount in the first section of the sampling tube (approximately 150 mg) is measured into a 2.5-inch, 4-mm ID glass tube, flame sealed at one end. This silica gel must be from the same batch as that used in obtaining the samples and can be obtained from unused silica gel tubes. The open end is capped with Parafilm.

A standard solution is prepared by placing 1,100 mg of the mixture of the isomers of cresol in a 10-ml volumetric flask and making it up to volume with n-hexane. A known amount of the standard solution is injected directly into the silica gel with a microliter syringe, and the tube is capped with more Parafilm. When an automatic sample injector is used, the sample injector vials, capped with Teflon-faced septa, may be used in place of the glass tubes.

The amount injected is equivalent to that present in a 20-liter air sample at the selected level. Six tubes at each of the three levels are prepared in this manner and allowed to stand for at least overnight to assure complete adsorption of the analyte onto the silica gel. These tubes are referred to as the samples. A parallel blank tube should be treated in the same manner except that no sample is added to it. The sample and blank

tubes are desorbed and analyzed in exactly the same manner as the sampling tube described in (d).

Two or three standards are prepared by injecting the same volume of compound into 1.0 ml of acetone with the same syringe used in the preparation of the samples. These are analyzed with the samples.

The desorption efficiency (DE) is dependent on the amount of analyte collected on the silica gel. The desorption efficiency equals the average weight in mg recovered from the tube divided by the weight in mg added to the tube, or

$$DE = \frac{\text{Average weight recovered (mg)}}{\text{Weight added (mg)}}$$

The desorption efficiency is dependent on the amount of analyte collected on the silica gel. Plot the desorption efficiency versus weight of analyte found. This curve is used to correct for adsorption losses.

Calibration and Standards

It is convenient to express concentration of standards in terms of mg/1.0 ml acetone, because samples are desorbed in this amount of acetone. A series of standards, varying in concentration over the range of interest, are prepared and analyzed under the same GC conditions and during the same time period as the unknown samples. Curves are established by plotting concentration in mg/1.0 ml versus total peak area. Note: Since no internal standard is used in the method, standard solutions must be analyzed at the same time that the sample analysis is done. This will minimize the effect of known day-to-day variations and variations during the same day of the flame-ionization detector response.

Calculations

(a) Read the weight, in mg, corresponding to each combined peak area from the standard curve. No volume corrections are needed, because the standard curve is based on mg/1.0 ml acetone and the volume of sample injected is identical to the volume of the standard injected.

(b) Corrections for the blank must be made for each sample.

$$\text{mg} = \text{mg sample} - \text{blank}$$

where:

mg sample = mg found in front section of sample tube

mg blank = mg found in front section of blank tube

A similar procedure is followed for the backup sections.

(c) Add the weights found in the front and backup sections to get the total weight in the sample.

(d) Read the desorption efficiency from the curve for the amount found in the front section. Divide the total weight by this desorption efficiency to obtain the corrected mg/sample.

$$\text{Corrected mg/sample} = \frac{\text{Total weight}}{\text{DE}}$$

(e) The concentration of the analyte in the air sampled can be expressed in mg/cu m.

$$\text{mg/cu m} = \frac{\text{Corrected mg} \times 1,000 \text{ (liters/cu m)}}{\text{Air volume sampled (liters)}}$$

(f) Another method of expressing concentration is ppm.

$$\text{ppm} = \text{mg/cu m} \times \frac{24.45}{\text{MW}} \times \frac{760}{\text{P}} \times \frac{\text{T} + 273}{298}$$

where:

P = pressure (mmHg) of air sampled
T = temperature (C) of air sampled
24.45 = molar volume (liter/mole) at 25 C and 760 mmHg
MW = molecular weight (g/mole) of analyte
760 = standard pressure (mmHg)
298 = standard temperature (K)

X. APPENDIX II
MATERIAL SAFETY DATA SHEET

The following items of information which are applicable to a specific product or material shall be provided in the appropriate block of the Material Safety Data Sheet (MSDS).

The product designation is inserted in the block in the upper left corner of the first page to facilitate filing and retrieval. Print in upper case letters as large as possible. It should be printed to read upright with the sheet turned sideways. The product designation is that name or code designation which appears on the label, or by which the product is sold or known by employees. The relative numerical hazard ratings and key statements are those determined by the rules in Chapter V, Part B, of the NIOSH publication, An Identification System for Occupationally Hazardous Materials. The company identification may be printed in the upper right corner if desired.

(a) Section I. Product Identification

The manufacturer's name, address, and regular and emergency telephone numbers (including area code) are inserted in the appropriate blocks of Section I. The company listed should be a source of detailed backup information on the hazards of the material(s) covered by the MSDS. The listing of suppliers or wholesale distributors is discouraged. The trade name should be the product designation or common name associated with the material. The synonyms are those commonly used for the product, especially formal chemical nomenclature. Every known chemical designation or

competitor's trade name need not be listed.

(b) Section II. Hazardous Ingredients

The "materials" listed in Section II shall be those substances which are part of the hazardous product covered by the MSDS and individually meet any of the criteria defining a hazardous material. Thus, one component of a multicomponent product might be listed because of its toxicity, another component because of its flammability, while a third component could be included both for its toxicity and its reactivity. Note that a MSDS for a single component product must have the name of the material repeated in this section to avoid giving the impression that there are no hazardous ingredients.

Chemical substances should be listed according to their complete name derived from a recognized system of nomenclature. Where possible, avoid using common names and general class names such as "aromatic amine," "safety solvent," or "aliphatic hydrocarbon" when the specific name is known.

The "%" may be the approximate percentage by weight or volume (indicate basis) which each hazardous ingredient of the mixture bears to the whole mixture. This may be indicated as a range or maximum amount, ie, "10-40% vol" or "10% max wt" to avoid disclosure of trade secrets.

Toxic hazard data shall be stated in terms of concentration, mode of exposure or test, and animal used, eg, "100 ppm LC50-rat," "25 mg/kg LD50-skin-rabbit," "75 ppm LC man," or "permissible exposure from 29 CFR 1910.1000," or, if not available, from other sources of publications such as the American Conference of Governmental Industrial Hygienists or the American National Standards Institute Inc. Flashpoint, shock sensitivity,

or similar descriptive data may be used to indicate flammability, reactivity, or similar hazardous properties of the material.

(c) Section III. Physical Data

The data in Section III should be for the total mixture and should include the boiling point and melting point in degrees Fahrenheit (Celsius in parentheses); vapor pressure, in conventional millimeters of mercury (mmHg); vapor density of gas or vapor (air = 1); solubility in water, in parts/hundred parts of water by weight; specific gravity (water = 1); percent volatiles (indicated if by weight or volume) at 70 degrees Fahrenheit (21.1 degrees Celsius); evaporation rate for liquids or sublimable solids, relative to butyl acetate; and appearance and odor. These data are useful for the control of toxic substances. Boiling point, vapor density, percent volatiles, vapor pressure, and evaporation are useful for designing proper ventilation equipment. This information is also useful for design and deployment of adequate fire and spill containment equipment. The appearance and odor may facilitate identification of substances stored in improperly marked containers, or when spilled.

(d) Section IV. Fire and Explosion Data

Section IV should contain complete fire and explosion data for the product, including flashpoint and autoignition temperature in degrees Fahrenheit (Celsius in parentheses); flammable limits, in percent by volume in air; suitable extinguishing media or materials; special firefighting procedures; and unusual fire and explosion hazard information. If the product presents no fire hazard, insert "NO FIRE HAZARD" on the line labeled "Extinguishing Media."

(e) Section V. Health Hazard Information

The "Health Hazard Data" should be a combined estimate of the hazard of the total product. This can be expressed as a TWA concentration, as a permissible exposure, or by some other indication of an acceptable standard. Other data are acceptable, such as lowest LD50 if multiple components are involved.

Under "Routes of Exposure," comments in each category should reflect the potential hazard from absorption by the route in question. Comments should indicate the severity of the effect and the basis for the statement if possible. The basis might be animal studies, analogy with similar products, or human experiences. Comments such as "yes" or "possible" are not helpful. Typical comments for cresol might be:

Skin Contact--single short contact, irritation, erythema; prolonged or repeated contact, chemical burn, skin discoloration, possible systemic effects.

Eye Contact--some pain and mild transient irritation; possible burning and conjunctivitis.

"Emergency and First Aid Procedures" should be written in lay language and should primarily represent first-aid treatment that could be provided by paramedical personnel or individuals trained in first aid.

Information in the "Notes to Physician" section should include any special medical information which would be of assistance to an attending physician including required or recommended preplacement and periodic medical examinations, diagnostic procedures, and medical management of overexposed employees.

(f) Section VI. Reactivity Data

The comments in Section VI relate to safe storage and handling of hazardous, unstable substances. It is particularly important to highlight instability or incompatibility to common substances or circumstances, such as water, direct sunlight, steel or copper piping, acids, alkalies, etc. "Hazardous Decomposition Products" shall include those products released under fire conditions. It must also include dangerous products produced by aging, such as peroxides in the case of some ethers. Where applicable, shelf life should also be indicated.

(g) Section VII. Spill or Leak Procedures

Detailed procedures for cleanup and disposal should be listed with emphasis on precautions to be taken to protect employees assigned to cleanup detail. Specific neutralizing chemicals or procedures should be described in detail. Disposal methods should be explicit including proper labeling of containers holding residues and ultimate disposal methods such as "sanitary landfill" or "incineration." Warnings such as "comply with local, state, and federal antipollution ordinances" are proper but not sufficient. Specific procedures shall be identified.

(h) Section VIII. Special Protection Information

Section VIII requires specific information. Statements such as "Yes," "No," or "If necessary" are not informative. Ventilation requirements should be specific as to type and preferred methods. Respirators shall be specified as to type and NIOSH or US Bureau of Mines approval class, ie, "Supplied air," "Organic vapor canister," etc. Protective equipment must be specified as to type and materials of construction.

(i) Section IX. Special Precautions

"Precautionary Statements" shall consist of the label statements selected for use on the container or placard. Additional information on any aspect of safety or health not covered in other sections should be inserted in Section IX. The lower bloc can contain references to published guides or in-house procedures for handling and storage. Department of Transportation markings and classifications and other freight, handling, or storage requirements and environmental controls can be noted.

(j) Signature and Filing

Finally, the name and address of the responsible person who completed the MSDS and the date of completion are entered. This will facilitate correction of errors and identify a source of additional information.

The MSDS shall be filed in a location readily accessible to employees exposed to the hazardous substance. The MSDS can be used as a training aid and basis for discussion during safety meetings and training of new employees. It should assist management by directing attention to the need for specific control engineering, work practices, and protective measures to ensure safe handling and use of the material. It will aid the safety and health staff in planning a safe and healthful work environment and in suggesting appropriate emergency procedures and sources of help in the event of harmful exposure of employees.

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MATERIAL SAFETY DATA SHEET

| I PRODUCT IDENTIFICATION | | |
|--|-------------------------------|--|
| MANUFACTURER'S NAME | REGULAR TELEPHONE NO. | |
| | EMERGENCY TELEPHONE NO | |
| ADDRESS | | |
| TRADE NAME | | |
| SYNONYMS | | |
| II HAZARDOUS INGREDIENTS | | |
| MATERIAL OR COMPONENT | % | HAZARD DATA |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| III PHYSICAL DATA | | |
| BOILING POINT, 760 MM HG | | MELTING POINT |
| SPECIFIC GRAVITY (H₂O=1) | | VAPOR PRESSURE |
| VAPOR DENSITY (AIR=1) | | SOLUBILITY IN H₂O, % BY WT |
| % VOLATILES BY VOL | | EVAPORATION RATE (BUTYL ACETATE 1) |
| APPEARANCE AND ODOR | | |

| IV FIRE AND EXPLOSION DATA | | | | |
|---|--|-------|-----------------------------|-------|
| FLASH POINT (TEST METHOD) | | | AUTOIGNITION TEMPERATURE | |
| FLAMMABLE LIMITS IN AIR, % BY VOL. | | LOWER | | UPPER |
| EXTINGUISHING MEDIA | | | | |
| SPECIAL FIRE FIGHTING PROCEDURES | | | | |
| UNUSUAL FIRE AND EXPLOSION HAZARD | | | | |
| V HEALTH HAZARD INFORMATION | | | | |
| HEALTH HAZARD DATA | | | | |
| ROUTES OF EXPOSURE | | | | |
| INHALATION | | | | |
| SKIN CONTACT | | | | |
| SKIN ABSORPTION | | | | |
| EYE CONTACT | | | | |
| INGESTION | | | | |
| EFFECTS OF OVEREXPOSURE | | | | |
| ACUTE OVEREXPOSURE | | | | |
| CHRONIC OVEREXPOSURE | | | | |
| EMERGENCY AND FIRST AID PROCEDURES | | | | |
| EYES | | | | |
| SKIN | | | | |
| INHALATION | | | | |
| INGESTION | | | | |
| NOTES TO PHYSICIAN | | | | |

| VI REACTIVITY DATA | |
|--|--|
| CONDITIONS CONTRIBUTING TO INSTABILITY | |
| INCOMPATIBILITY | |
| HAZARDOUS DECOMPOSITION PRODUCTS | |
| CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION | |
| VII SPILL OR LEAK PROCEDURES | |
| STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED | |
| NEUTRALIZING CHEMICALS | |
| WASTE DISPOSAL METHOD | |
| VIII SPECIAL PROTECTION INFORMATION | |
| VENTILATION REQUIREMENTS | |
| SPECIFIC PERSONAL PROTECTIVE EQUIPMENT | |
| RESPIRATORY (SPECIFY IN DETAIL) | |
| EYE | |
| GLOVES | |
| OTHER CLOTHING AND EQUIPMENT | |

IX SPECIAL PRECAUTIONS

PRECAUTIONARY
STATEMENTS

OTHER HANDLING AND
STORAGE REQUIREMENTS

PREPARED BY _____

ADDRESS _____

DATE _____

XI. TABLES AND FIGURES

TABLE XI-1

PHYSICAL AND CHEMICAL PROPERTIES OF CRESOL

| | o-Cresol | m-Cresol | p-Cresol |
|---|--|--|--|
| Molecular formula | CH ₃ C ₆ H ₄ OH | CH ₃ C ₆ H ₄ OH | CH ₃ C ₆ H ₄ OH |
| Formula weight | 108.13 | 108.13 | 108.13 |
| Appearance | Colorless crystals or liquid | Colorless liquid | Colorless crystals |
| Boiling point | 191.0 C | 202.7 C | 201.9 C |
| Melting point | 30.9 C | 12.0 C | 34.8 C |
| Vapor pressure (at 25 C) | 0.25 mmHg | 0.15 mmHg | 0.11 mmHg |
| Specific gravity at 20 C (water = 1.000 at 4 C) | 1.048 | 1.034 | 1.035 |
| Saturated concentration (at 20 C) | 1,428 mg/cu m (323 ppm) | 888 mg/cu m (201 ppm) | 628 mg/cu m (142 ppm) |
| Flashpoint (closed cup) | 81.1 C | 86.1 C | 86.1 C |
| Autoignition temperature | 559 C | 626 C | 559 C |
| Vapor density (air = 1) | 3.72 | 3.72 | 3.72 |
| Odor threshold | 0.0028 mg/cu m (0.00063 ppm) | 0.034 mg/cu m (0.0076 ppm) | 0.0021 mg/cu m (0.00047 ppm) |
| Oil/water partition coefficient | 1.34 | 1.21 | 1.21 |
| Solubility in water (by weight at 25 C) | 2.5% | 2.2% | 1.9% |
| Solubility in other substances | Soluble in alcohol and caustic alkalies; miscible with benzene, ether, and petroleum ether | | |
| Conversion factors (760 mmHg and 25 C) | 1 ppm = 4.42 mg/cu m; 1 mg/cu m = 0.226 ppm | | |

Adapted from references 1-7

TABLE XI-2

OCCUPATIONS WITH POTENTIAL EXPOSURE TO CRESOL

| | |
|---------------------------|--------------------------------|
| Antioxidant producers | Paint remover makers |
| Coal tar workers | Paint removers |
| Cresol soap makers | Perfume makers |
| Cresol workers | Phenolic resin producers |
| Cresylic acid makers | Phosphate ester producers |
| Deodorant workers | Photographic developer workers |
| Disinfectant makers | Pitch workers |
| Disinfectors | Resin makers |
| DNOC producers | Roofers |
| Dyemakers | Rubber makers |
| Enamel makers | Scouring compound makers |
| Explosive workers | Stainers |
| Flotation agent makers | Stain makers |
| Flotation workers | Surfactant makers |
| Foundry workers | Tanning agent makers |
| Glue workers | Tar distillery workers |
| Ink makers | Textile sizers |
| Ink remover makers | Varnish remover makers |
| Ink removers | Varnish removers |
| Insecticide workers | Veterinarians |
| Insulation enamel workers | Wool scourers |
| Oil additive makers | |

Adapted from references 8-10

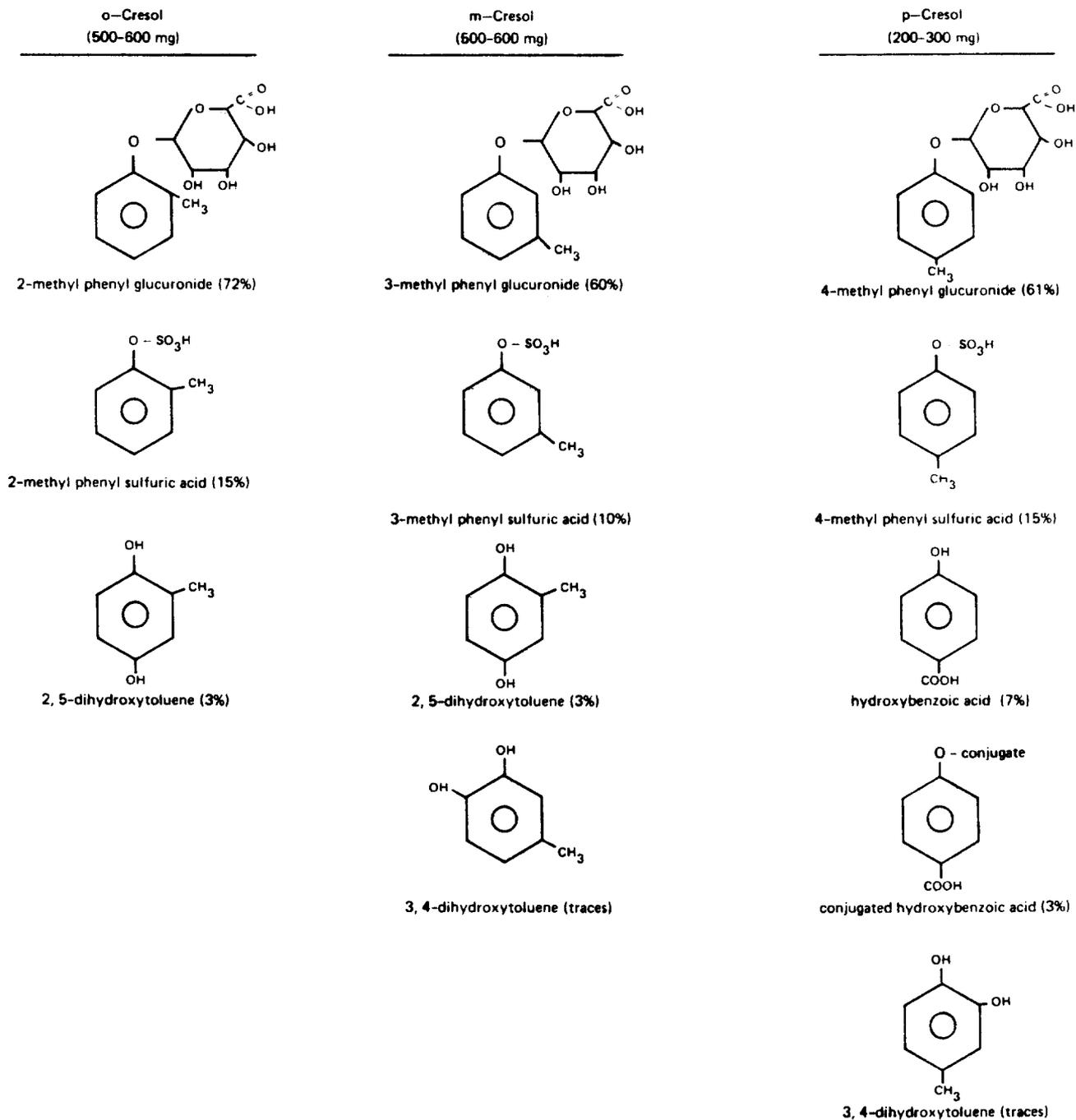


FIGURE XI-1

URINARY PRODUCTS OF CRESOL ADMINISTERED BY STOMACH TUBE TO RABBITS

Adapted from Bray et al [36]

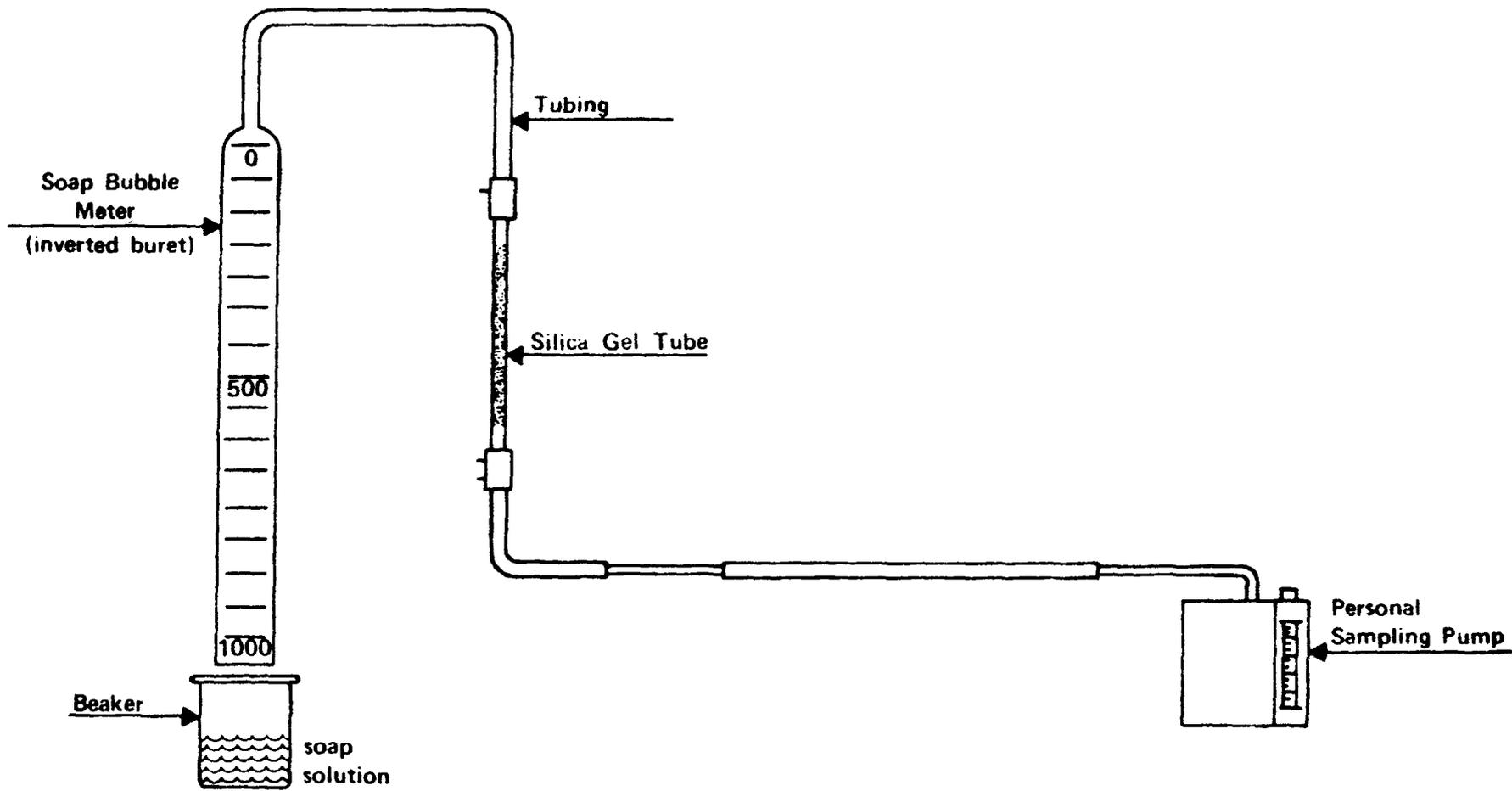


FIGURE XI-2
CALIBRATION SETUP FOR PERSONAL SAMPLING WITH SILICA GEL TUBE