AOCS

AOCS Criteria M 5a-2023
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Approved Chemists (Criteria)

DEFINITION The AOCS Examination Board Approved Chemist is a chemist recognized as proficient in the use of AOCS methodologies utilized in the Laboratory Proficiency Program. The chemist must participate in the Program series in which approval is requested. Approval entitles the chemist to act as a referee for those analyses consistent with the Laboratory Proficiency Program series for which Approved Chemist status is granted.

SCOPE All chemists/technicians employed by independent and industrial laboratories (there must be no conflict of interest when analyses are performed at industrial laboratories) may elect to pursue initial and continued Approved Chemist status. Approval is granted for one year and the chemist/technician must both apply for approval and demonstrate satisfactory performance on a yearly basis.

PROCEDURE

1. Application—
   (a) Any chemist wishing to be considered for Approved Chemist status must first be able to demonstrate the ability to perform the required analyses. This includes:
   —Having an existing facility in which to perform the appropriate analyses *at the time of application.*
   —Having all apparatus and reagents required by AOCS methodology *at the time of application.*
   —Being willing to allow members of the AOCS Examination Board (or designated representatives) to inspect the laboratory facilities.
   (b) Completion of the application form and submission of the application and administrative fees.[1]
   —Application available at www.aocs.org/attain-lab-services/laboratory-proficiency-program.
   —Applications must be received at AOCS Headquarters by the final date.
2. Categories of approval, required analyses and number of samples
   Applicants may request approval in any of the Laboratory Proficiency Program series. The required analyses on each sample in each series must be completed.
3. Criteria for approval—
   (a) Successful completion of the proficiency series in which approval is sought is determined by meeting the following criteria:
   —A score on an individual series must be less than 1.4.
   —Absolutely no missing results for samples or required constituents. If there are mitigating circumstances surrounding missing samples and results, it will be necessary to send a letter to the AOCS Lab Proficiency Program Manager, indicating the circumstances so that special consideration may be given.
   (b) The initial failure to meet the criteria will result in a probationary period of one year. If the problem is not resolved during that year, approval will not be granted the following year.
4. Approval is granted *only* to the individual named in the application, who must also be the same individual who participates in the Laboratory Proficiency Program series in which approval is requested. Approved Chemist status is not transferable from one individual to another. Approval does not necessarily imply automatic transfer when an Approved Chemist moves from one facility to another either within the same organization or with a new organization.
5. Transfers—If the Approved Chemist transfers before the end of a certification period, the approved status changes to approved on probation. In these cases, the AOCS Examination Board chairman must be notified, in writing, regarding the following:
   —Name and address of new location.
   —Explanation of reason for change of location.
   —That the new location has the necessary facilities, apparatus, and reagents to perform the analyses for which the chemist is approved.

Refer to the AOCS Laboratory Safety chapter when using this Method.

If there are concerns about the new facility to which the Approved Chemist has transferred, it will be necessary for members of the AOCS Examination Board (or designated representatives) to inspect the laboratory facilities before continued approval can be granted.

6. Foreign approval—Individuals in foreign countries wanting to become Approved Chemists must comply with the criteria outlined in this procedure. However, if circumstances warrant special consideration, the need for special consideration will be determined by consensus of the AOCS Examination Board. Special consideration will be given only by consensus of the AOCS Examination Board and only to the extent that the integrity of the Program is not compromised.
7. Participant results will be made available by June 1 of each year. After June 1, those chemists on probation or disapproved may appeal to the AOCS Examination Board between June 1 and July 1, but no later than July 1 (or four weeks from the date of notification, whichever is later). The finalized listing of Approved Chemists will be made public by August 1.[2]
8. Appeal procedures—Appeals will be considered for the following issues:
   (a) Errors in LPP sample instructions.

   Appeals will not be considered for the following issues:

   (b) Participant data reporting errors.
   (c) Statistical methods used for data analysis.
   (d) Failure of participant to adhere to posted deadlines.
   (e) The Examination Board shall, in its sole discretion, determine whether or not any other circumstance or grounds for appeal shall be considered if not specified above.

   Approved Chemist Appeals:

   (f) Appeal proceedings and the identities of appellants are strictly confidential.
   (g) Participants that have failed to qualify for Approved Chemist status may appeal to the Examination Board.
   (h) A written appeal is due four weeks from the date of notification or July 1, whichever is later. The Appellant should mail their appeal to the Director of Technical Services and the AOCS Technical Services Manager responsible for administration of the Approved Chemists program. The appeal must include the basis for the appeal and all supporting documentation necessary to conduct a thorough review. There is no standard appeal form.
   (i) The written appeal is forwarded to the full Examination Board, who vote on each appeal. Any member of the examining Board having a direct economic or personal interest in the outcome of the proceedings shall be recused. The Chair of the Examination Board tallies the votes and notifies the Director of Technical Services and the AOCS Technical Services Manager responsible for administration of the Approved Chemists program of the outcome. A simple majority is required. The Appellant is then notified by email from AOCS of the decision.
   (j) In the event the Appellant is dissatisfied with the outcome of the Examination Board's vote, they may request an oral hearing before the Examination Board to appeal the finding of failure to qualify for certification.
   (k) If the Appellant elects for an oral hearing, AOCS will schedule a call or online appeal meeting.
   (l) The following further conditions apply if the Appellant elects for an oral hearing:
      i. The Appellant has the right to be represented at the hearing by another person, including an attorney.
      ii. The Appellant has the right to submit evidence and arguments relevant to the decision.
      iii. The Appellant has the right to call and cross-examine witnesses (if applicable).
   (m) At the conclusion of the hearing, the Examination Board will consider all testimony and evidence offered and make its final determination. A simple majority is required. The Appellant will be provided a written decision identifying the Examination Board's reasoning for its decision. The Appellant has the right to appeal an adverse decision in writing to the AOCS Governing Board within ten (10) days of receiving the Examination Board's decision. The decision of the AOCS Governing Board is final and may not be appealed.

NOTES

[1] The application and administrative fees are subject to change at the discretion of the AOCS Examination Board.

[2] Approved Chemist listings are published yearly in *Inform* magazine, the *AOCS Directory,* and on the AOCS home page (www.aocs.org).

AOCS Laboratory Safety

INTRODUCTION

The following sections do not contain complete listings of all the elements involved in laboratory safety. These precautionary notes serve as a reminder of possible hazards involved in the use of particular operations or substances, especially those items and materials frequently used in AOCS methods. The user of these methods should refer to standard texts on laboratory safety for a more complete treatment of the subject. Follow safety requirements and rules issued by voluntary organizations and government agencies [Occupational Safety and Health Administration (OSHA), in particular] expert in the field of laboratory safety.

EQUIPMENT

Blenders, grinders, electrical equipment—Motors on high-speed blenders used to mix flammable solvents with other material should be rated for use with the materials in question and in the class and division rating of the lab where the work is being performed. Blend toxic or flammable liquids in an effective fume-removal area. Accidents involving electrical equipment may result in mechanical injury, e.g., fingers are being caught in chopping mill knives or grinders; electrical shock, which may be due to lack of or improper grounding, defective equipment, exposed wiring, or inadequate maintenance; and fire through ignition of flammable vapors by electrical sparks. Ground all electrical equipment. Installation, maintenance, and repair operations should be performed by qualified electricians.

Atomic absorption spectrophotometer—Use effective fume-removal device to remove gaseous effluents from burner. Use specially designed exhausts when nitrous oxide (N_2O) is used as a fuel oxidant. If instrument has drain trap, check to ensure it is filled with water before igniting burner. Explosions of fuel gas accumulated through drain traps have been reported.

Compressed gas cylinders—Identify contents (by means of attached decal, stencil or tag) of compressed gas cylinders by name of gas contained in the cylinder rather than by color codes. Secure cylinders in upright position by means of strap, chain, or nontip base. Use only correct pressure gages, pressure regulator, and flow regulator for each size of gas cylinder and type of gas, as specified by supplier. Use toxic gases only in effective fume-removal areas. When burning gas or performing a reaction, use back flow prevention device in gas line to prevent flame or reaction from being sucked back into cylinder.

Distillations, extractions, evaporations—For flammable liquids, perform operations behind safety barrier with hot water, steam, or electric mantel heating. Do not use open flames to heat flammable liquids. Use effective fume-removal device to remove flammable vapors as they are produced. Set up apparatus on firm supports and secure all connections. Leave ample headroom in flask and add boiling chips before heating begins. All controls, unless vapor sealed, should be located outside vapor area. For toxic liquids, use effective fume-removal device to remove toxic vapors as they are produced. Avoid contact with skin and inhalation of vapors. Store and dispose of toxic solvents in the manner prescribed by the Environmental Protection Agency (EPA) and OSHA.

Vacuum—Any apparatus to be used under vacuum shall be coated, taped, or otherwise treated to minimize effects of possible implosion, and a safety shield in place during operation. Vacuum pump drive belts must have effective guards.

ACIDS

Use effective acid-resistant fume-removal device whenever heating acids or performing reactions which liberate acid fumes. When diluting acids, always add acid to water, unless otherwise directed in a method. Keep acids off skin, and protect eyes when working with acids. If acids come in contact with skin or eyes, wash immediately with large amounts of water. Do not store oxidizing acids (perchloric, nitric, sulfuric) near organic materials. Mixing organic materials with these acids, particularly perchloric, could result in an explosion.

Acetic acid in the pure state is moderately toxic by ingestion and inhalation. It is a strong irritant to skin and tissue. The threshold limit value in air is 10 ppm.

Hydrochloric acid is a strong acid and will cause severe burns. Protective clothing should be worn when working with this acid. It is toxic by ingestion and inhalation and a strong irritant to eyes and skin. The use of a properly operating fume hood is recommended. When diluting the acid, always add the acid to the water, never the reverse.

Hydrogen bromide gas and hydrobromic acid are toxic by inhalation and strong irritants to eyes and skin. Use a properly operating fume hood when working with these compounds.

Nitric acid is a highly corrosive and toxic oxidizing agent. Use effective acid-resistant fume-removal device whenever heating acids or performing reactions that liberate acid fumes. When diluting acids, always add acid to water unless otherwise directed in a method. Keep acids off skin and protect eyes when working with acids. If acids come in contact with skin or eyes, wash immediately with large amounts of water. Do not store oxidizing acids (perchloric, nitric, sulfuric) near organic materials. Mixing organic materials with these acids, particularly perchloric, could result in an explosion.

Periodic acid is an oxidizing agent and is dangerous in contact with organic materials. It is a strong irritant. It decomposes at 130 °C. Do not use cork or rubber stoppers on storage bottles.

Sulfuric acid is a strong acid and will cause severe burns. Protective clothing should be worn when working with this acid. It is a dehydrating agent and should not be stored in the vicinity of organic materials. Use great caution in mixing with water due to heat evolution that can cause explosive spattering. Always add the acid to water, never the reverse.

ALKALIS

Alkalis can burn skin, eyes, and respiratory tract severely. Wear heavy rubber gloves and face shield to protect against concentrated alkali liquids. Use effective fume-removal device or gas mask to protect respiratory tract against alkali dusts or vapors. When working with extremely caustic materials, like sodium hydroxide and potassium hydroxide, always add pellets to water and not vice versa. These alkalis are extremely exothermic when mixed with water. Take precautions to contain the caustic solution in the event the mixing container breaks from the extreme heat generated.

Potassium hydroxide can severely burn skin, eyes, and respiratory tract. Wear heavy rubber gloves and face shield to protect against concentrated alkali liquid splash. Use effective fume-removal device or gas mask to protect respiratory tract against alkali dusts or vapors. When working with extremely caustic materials, such as potassium hydroxide, always add the pellets to the water and not the reverse.

Sodium hydroxide can severely burn skin, eyes and respiratory tract. Protective clothing should be worn when working with this alkali. Wear heavy rubber gloves and face shield to protect against concentrated alkali liquid splash. Use effective fume-removal device or gas mask to protect respiratory tract against alkali dusts or vapors. When working with extremely caustic materials, such as sodium hydroxide, always add pellets to water and not the reverse.

SOLVENTS

Vapors from some volatile solvents are highly toxic. Several of these solvents are readily absorbed through the skin. Do not let vapors concentrate to a flammable level in the work area, because it is nearly impossible to eliminate all chances of sparks from static electricity, even though electrical equipment is grounded. Use effective fume-removal device to remove solvent vapors as they are liberated.

Acetone is a highly flammable solvent. Forms explosive peroxides with oxidizing agents. Use effective fume-removal device. Do not mix with chloroform.

Acetonitrile is a flammable solvent. There is toxic action by skin absorption and inhalation. A fume hood should be used at all times when using acetonitrile.

Aniline is an organic chemical compound consisting of a benzene ring attached to an amino group. Acute exposure can cause upper respiratory tract irritation and congestion.

Benzene is a highly toxic and highly flammable solvent. Avoid contact with the skin. Do not breathe vapors. Use effective fume-removal device. Decomposes violently in the presence of strong oxidizing agents. Reacts violently with chlorine. Benzene is a cancer-causing agent.

Carbon disulfide is a colorless, highly-flammable poisonous liquid. It is harmful either by inhalation, prolonged or repeated skin contact, or by ingestion. Chronic poisoning may ensue from repeated exposure to vapor. It is a dangerous fire and explosion risk, and can be ignited by friction. Extreme precautions should be taken when using this solvent. A fume hood should be used at all times when handling this solvent.

Carbon tetrachloride is a known carcinogen. It is toxic by ingestion, inhalation, and skin absorption. It is a narcotic. It should not be used to extinguish fires. It decomposes to phosgene gas at high temperature. It reacts violently with alkali metals. A fume hood should be used at all times when handling this solvent.

Chlorobenzene is a colorless flammable liquid. It has a moderate fire risk. Explosive limits are 1.8–9.6% v/v in air. Avoid inhalation and skin contact. The threshold limit

value is 10 ppm in air. Chlorobenzene and trichlorobenzene are toxic by ingestion and inhalation. Use a properly operating fume hood when working with this solvent.

Chloroform is a known carcinogen. It is toxic by inhalation and has anesthetic properties. Avoid contact with the skin. Prolonged inhalation or ingestion can lead to liver and kidney damage and may be fatal. It is nonflammable, but will burn on prolonged exposure to flame or high temperature, forming phosgene gas when heated to decomposition temperatures. Can react explosively with aluminum, lithium, magnesium, sodium, potassium, disilane, N_2O_4, and sodium hydroxide + methanol. The threshold limit value is 10 ppm in air. A fume hood should be used at all times when using chloroform.

Cylcohexane is a highly flammable liquid. It may be fatal if swallowed or inhaled, and can cause skin irritation. Use effective fume-removal device. Can react vigorously with strong oxidizing agents.

Dichloromethane (methylene chloride) is toxic and a carcinogen that will emit highly toxic fumes and phosgene gas when heated. The OSHA permissible exposure limit is 25 ppm in air. A fume hood should be used at all times when using methylene chloride.

Diethyl ether (ethyl ether) is an extremely flammable liquid, and a severe fire and explosion hazard when exposed to heat or flame. It is a central nervous system depressant by inhalation and skin absorption. Store protected from the light. It will form explosive peroxides upon exposure to light. Handle empty containers, particularly those from which ether has evaporated, with extreme caution. Explosive limits in air are 1.85–48% v/v. The threshold limit value is 400 ppm in air. Can react explosively when in contact with chlorine, ozone, lithium aluminum hydride, or strong oxidizing agents. A fume hood should be used at all times when using ethyl ether. Avoid static electricity.

Dimethylformamide is a clear flammable liquid and a strong irritant to skin and tissue. It is toxic by skin absorption. The threshold limit value is 5 ppm in air.

Ethanol (ethyl alcohol) is a clear, colorless, highly flammable liquid. Use effective fume-removal device when heating or evaporating.

Hexane is a highly flammable solvent and a dangerous fire risk. All work should be performed in a fume hood, with no open flames. The threshold limit value for hexane is 50 ppm in air. OSHA recommends that exposure not exceed 500 ppm for a time-weighted average. Hexane vapor causes lung irritation and produces neurotoxic effects.

Heptane is a highly flammable liquid and a dangerous fire risk. Vapors may cause lung irritation and may produce neurotoxic effects. A fume hood should be used at all times when using this solvent.

Methanol (methyl alcohol) is flammable liquid, and toxic. Avoid contact with eyes. Avoid breathing vapors. Use effective fume-removal device. Can react vigorously with sodium hydroxide + chloroform, potassium hydroxide + chloroform, and perchloric acid.

Methyl isobutyl ketone (MIBK) is a clear, colorless, and highly flammable liquid and a dangerous fire risk. Explosive limits in air are 1.4–7.5% v/v. Avoid inhalation and ingestion. It is absorbed by the skin. The threshold limit value is 20 ppm in air.

Petroleum ether is the petroleum fraction consisting of aliphatic hydrocarbons in the boiling range 35–60 °C. The term *ether* is only figurative, signifying extreme lightness and volatility. It is extremely flammable. The explosive limits in air are 1–6% v/v. Use effective fume-removal device. Avoid static electricity.

Pyridine is a clear liquid with a distinct odor, is highly flammable and a dangerous fire risk. The explosive limits in air are 1.8–12.4% v/v. It is toxic by ingestion and inhalation. The threshold limit value is 1 ppm in air. The danger from crude pyridine is greater than from pure pyridine, the associated homologs and impurities being even more toxic than pyridine itself.

Tetrachloroethylene (perchloroethylene) is a colorless, volatile, nonflammable liquid chlorinated hydrocarbon that will emit toxic fumes of phosgene when exposed to sunlight or flames. It is an irritant to eyes and skin. The threshold limit value is 25 ppm in air.

Tetrahydrofuran is a highly flammable liquid and a dangerous fire risk. The flammable limits in air are 2–11% v/v. It is toxic by ingestion and inhalation. The threshold limit value in air is 50 ppm. It tends to form peroxides upon storage in air.

Toluene is a highly flammable liquid and a dangerous fire risk. Explosive limits in air are 1.27–7% v/v. It is toxic by ingestion, inhalation, and skin absorption. The threshold limit value is 20 ppm in air. A fume hood should be used at all times when using toluene.

1,1,1-Trichloroethane is a synthetic, light-sensitive, volatile, colorless, liquid miscible with many nonpolar organic solvents. It is an irritant to eyes and skin. The threshold limit value is 350 ppm in air.

Xylene is flammable and a dangerous fire risk. The OSHA permissible exposure limit is 100 ppm in air.

CHEMICALS

Chlorine is a poisonous gas. The threshold limit value is 0.1 ppm in air. It is a strong oxidizing agent and should not be allowed to come in contact with organic materials, hydrogen, powdered metals, and reducing agents. A fume hood should be used at all times when using chlorine.

Gossypol is toxic by ingestion. Avoid contact with particulate matter when working with standards. It is inactivated by heat.

Hydrazine sulfate can cause eye, skin, and mucous membrane irritation and liver and kidney damage. This compound is a known carcinogen in laboratory animals, causing lung and liver tumors in rats. It is a suspected human carcinogen. Precautions should be taken in handling this compound—use gloves, eye protection, and respiratory protection. Avoid the inhalation of dust and powder. Dispose of waste material and waste solutions in a proper and safe manner.

Lead acetate is toxic by ingestion, inhalation, and skin absorption.

Mercury vapors and compounds are extremely toxic and cumulative. Hazardous in contact with ammonia, halogens, and alkali. Regard spills on hot surfaces as extremely hazardous and clean up promptly. Powdered sulfur sprinkled over spilled mercury can assist in cleaning up spills. High degree of personal cleanliness is necessary for persons who use mercury. Handle only in locations that can be readily and completely cleaned up. When mercury evaporation is required, use effective fume-removal device. To avoid environmental contamination, dilute liquid remaining in Kjeldahl digestion flasks to about 300 mL with water, cool to room temperature, and add 50 mL 30% w/w hydrogen peroxide. (If Raney powder method is used, 6 mL of hydrogen peroxide is sufficient.) Warm gently to initiate reaction, let reaction go to completion in warm flask, and separate precipitated mercuric sulfide. Reserve precipitate in closed, labeled container for recovery of mercury or disposal by EPA requirements.

Potassium dichromate is toxic by ingestion and inhalation. There is sufficient evidence in humans for the carcinogenicity of chromium [+6], in particular lung cancer. It is a strong oxidizing agent and a dangerous fire risk in contact with organic chemicals.

Sylon BFT is a powerful silylating reagent, composed of mixing 1 part trimethyl chlorosilane with 99 parts of bistrimethylsilyl-trifluoroacetamide, and should be used only in a properly operating fume hood. This reagent is highly flammable.

tert-Butyl methyl ether is extremely flammable and toxic. Avoid inhalation, ingestion, and eye or skin contact. The threshold limit value is 50 ppm in air. Respiratory irritation, dizziness, and disorientation have been reported. A fume hood should be used at all times when using *tert*-Butyl methyl ether.

Wijs solution, iodine monochloride, causes severe burns, and the vapors can cause lung and eye damage. Use of a fume hood is recommended. Wijs solution without carbon tetrachloride is available commercially.

ADDITIONAL MATERIALS

Castor seeds are poisonous due to the presence of ricin, a highly toxic albumin, and ricinine, a highly toxic alkaloid. Neither pressing nor extraction removes them; hence both hazards remain in the pomace. They also contain an allergenic protein polysaccharide (CB-1A) that is among the most powerful known allergens. It is strongly recommended that workers wear rubber gloves when preparing analytical samples, and that they avoid inhaling any of the dust arising from the castor beans by working near an air exhaust or in a well ventilated laboratory hood.

Fumonisins are hepatotoxic and carcinogenic to rats; effects on humans are not fully known. Wear protective gloves to reduce skin contact with corn extracts. Any laboratory spillages should be washed with a 5% w/w aqueous solution of commercial sodium hypochlorite followed by H_2O. (Dispose of waste solvents according to applicable environmental rules and regulations.)

Mycotoxins should be handled with extreme care because they are highly toxic substances. Perform manipulations under a properly operating fume hood. Take particular precautions, such as the use of a glove box, when toxins are in dry form, because of their electrostatic nature and resulting tendency to disperse in working areas. Swab accidental spills of toxin with 5% w/w sodium hypochlorite bleach. Rinse all glassware exposed to toxins with 1% w/w sodium hypochlorite bleach solution and then wash thoroughly with warm water.

REFERENCES

Official Methods of Analysis, Association of Official Analytical Chemists, 14th edn., 1984, pp. 1010–1015.

Standard Methods for the Analysis of Oils, Fats and Derivatives, 7th edn., Blackwell Scientific Publications, 1987.

Hawley's Condensed Chemical Dictionary, 11th edn., revised by N. I. Sax and R. J. Lewis, Jr., 1987.