Registration Form

Arsenic CEU Training Course $200.00

48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL $50.00

Start and Finish Dates: _____

You will have 90 days from this date in order to complete this course

List number of hours worked on assignment must match State Requirement. _____

Name_____Signature_____

I have read and understood the disclaimer notice on page 2. Digitally sign XXX

Address_____

City_____State_____Zip_____

Email_____ Fax (____) _____

Phone:
Home (____) _____ Work (____) _____

Operator ID #_____Exp. Date_____

Please circle/check which certification you are applying the course CEU's.
Pretreatment ___ Collection___ Wastewater Treatment ___

Other _____

Technical Learning College TLC PO Box 3060, Chino Valley, AZ 86323
Toll Free (866) 557-1746 Fax (928) 272-0747 info@tlch2o.com

If you've paid on the Internet, please write your Customer#_____

Please invoice me, my PO#_____

We will stop mailing the certificate of completion so we need either your fax number or e-mail address. We will e-mail the certificate to you, if no e-mail address; we will fax it to you.

DISCLAIMER NOTICE

I understand that it is my responsibility to ensure that this CEU course is either approved or accepted in my State for CEU credit. I understand State laws and rules change on a frequent basis and I believe this course is currently accepted in my State for CEU or contact hour credit, if it is not, I will not hold Technical Learning College responsible. I fully understand that this type of study program deals with dangerous, changing conditions and various laws and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable in any fashion for any errors, omissions, advice, suggestions or neglect contained in this CEU education training course or for any violation or injury, death, neglect, damage or loss of your license or certification caused in any fashion by this CEU education training or course material suggestion or error or my lack of submitting paperwork. It is my responsibility to call or contact TLC if I need help or assistance and double-check to ensure my registration page and assignment has been received and graded. It is my responsibility to ensure all information is correct and to abide with all rules and regulations.

State Approval Listing Link, check to see if your State accepts or has pre-approved this course. Not all States are listed. Not all courses are listed. If the course is not accepted for CEU credit, we will give you the course free if you ask your State to accept it for credit.

Professional Engineers; Most states will accept our courses for credit but we do not officially list the States or Agencies. Please check your State for approval.

State Approval Listing URL…

http://www.abctlc.com/downloads/PDF/CEU%20State%20Approvals.pdf

You can obtain a printed version of the course manual from TLC for an additional $169.95 plus shipping charges.

AFFIDAVIT OF EXAM COMPLETION

I affirm that I personally completed the entire text of the course. I also affirm that I completed the exam without assistance from any outside source. I understand that it is my responsibility to file or maintain my certificate of completion as required by the state or by the designation organization.

Grading Information

In order to maintain the integrity of our courses we do not distribute test scores, percentages or questions missed. Our exams are based upon pass/fail criteria with the benchmark for successful completion set at 70%. Once you pass the exam, your record will reflect a successful completion and a certificate will be issued to you.

For security purposes, please fax or e-mail a copy of your driver's license and always call us to confirm we've received your assignment and to confirm your identity.

CERTIFICATION OF COURSE PROCTOR

Technical Learning College requires that our students who takes a correspondence or home study program course must pass a proctored course reading, quiz and final examination. The proctor must complete and provide to the school a certification form approved by the commission for each examination administered by the proctor.

Instructions. When a student completes the course work, fill out the blanks in this section and provide the form to the proctor with the examination.

Name of Course:_____

Name of Licensee:_____

Instructions to Proctor. After an examination is administered, complete and return this certification and examination to the school in a sealed exam packet or in pdf format.

I certify that:

1. I am a disinterested third party in the administration of this examination. I am not related by blood, marriage or any other relationship to the licensee which would influence me from properly administering the examination.
2. The licensee showed me positive photo identification prior to completing the examination.
3. The enclosed examination was administered under my supervision on _____ ___. The licensee received no assistance and had no access to books, notes or reference material.
4. I have not permitted the examination to be compromised, copied, or recorded in any way or by any method.
5. Provide an estimate of the amount of time the student took to complete the assignment.

Time to complete the entire course and final exam. _____

Notation of any problem or concerns:

Name and Telephone of Proctor (please print):

_____

_____
Signature of Proctor

Arsenic Answer Key

Name _____ Phone_____

Did you check with your State agency to ensure this course is accepted for credit?

Method of Course acceptance confirmation. Please fill this section

Website __ Telephone Call___ Email____ Spoke to_____

Did you receive the approval number, if applicable? _____

What is the course approval number, if applicable? _____

You are responsible to ensure that TLC receives the Assignment and Registration Key. Please call us to ensure that we received it. No refunds.

You can also fill this assignment out electronically in Adobe Acrobat DC

Please write down any questions that cannot be found or has problems

Please circle, underline, bold or X only one correct answer
A felt tipped pen works best.

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When finished with your assignment.

Please scan the Registration Page, Answer Key and Driver's License and email it to info@TLCH2O.com.

If you are unable to scan, take a photo of these documents with your iPhone and send these to TLC, info@TLCH2O.com.

If you are unable to scan and email, please fax these to TLC,

(928) 468-0675
If you fax, call to confirm that we received your paperwork.

This course contains general EPA's SDWA and CWA federal rule requirements. Please be aware that each state implements water / wastewater / safety / environmental / building regulations that may be more stringent than EPA's regulations. Check with your state environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to not be in non-compliance and do not follow this course for proper compliance.

Please e-mail or fax this survey along with your final exam

ARSENIC CEU TRAINING COURSE

CUSTOMER SERVICE RESPONSE CARD

NAME: _____

E-
MAIL_____PHONE_____

PLEASE COMPLETE THIS FORM BY CIRCLING THE NUMBER OF THE APPROPRIATE ANSWER IN THE AREA BELOW.

1. Please rate the difficulty of your course.
Very Easy 0 1 2 3 4 5 Very Difficult

2. Please rate the difficulty of the testing process.
Very Easy 0 1 2 3 4 5 Very Difficult

3. Please rate the subject matter on the exam to your actual field or work.
Very Similar 0 1 2 3 4 5 Very Different

4. How did you hear about this Course? _____

5. How would you improve the course?

_____

_____

How about the price of the course?

Poor_____ Fair ____ Average ____ Good____ Great_____

How was your customer service?

Poor___ Fair ____ Average ____ Good _____ Great_____

Any other concerns or comments.

_____

_____

I will not hold TLC liable for any errors, injury, death or non-compliance with rules. I will abide with all federal and state rules and rules found on page 2.

I understand that I am 100 percent responsible to ensure that TLC receives the Assignment and Registration Key and that it is accepted for credit by my State or Providence. I understand that TLC has a zero tolerance towards not following their rules, cheating or hostility towards staff or instructors. I need to complete the entire assignment for credit. There is no credit for partial assignment completion. My exam was proctored. I will contact TLC if I do not hear back from them within 2 days of assignment submission. I will forfeit my purchase costs and will not receive credit or a refund if I do not abide with TLC's rules. I will not hold TLC liable for any errors, injury, death or non-compliance with rules. I will abide with all federal and state rules and rules found on page 2.

Please Sign that you understand and will abide with TLC's Rules.

_____

Signature

Please write down any questions you were not able to find the answers or that have errors.

Arsenic CEU Training Course Assignment

You will have 90 days from the start of this assignment to have successfully completed and submit this assignment back to TLC.

If you need course assistance, please call us at (928) 468-0665 or go to the Assistance Page on TLC's website. You can find online assistance for this course on the in the Search function on Adobe Acrobat PDF to help find the answers.

Arsenic Introduction
Metalloid

1. Arsenic is *a chemical element* with symbol _____ and the atomic number is _____.
A. AR – 35 C. As - 33
B. AS – 13 D. None of the above

2. Arsenic happens in many minerals, usually in conjunction with _____, and also as a pure elemental crystal. It was first documented by Magnus back in the year 1250.
A. Sulfur and metals C. Alloys of copper
B. Inorganics D. None of the above

3. Arsenic a metalloid and can exist in _____, although only the gray form has important use in industry.
A. Various allotropes C. Inorganic forms
B. The trioxide D. None of the above

4. In the year 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine the level of contaminants in drinking water at which no _____are likely to occur.
A. Adverse health effects C. These non-enforceable health goals
B. MCLG D. None of the above

5. Which of the following is based solely on possible health risks and exposure over a lifetime with an adequate margin of safety, are called maximum contaminant level goals?
A. Adverse health effects C. These non-enforceable health goals
B. MCLG D. None of the above

6. Which of the following are any physical, chemical, biological or radiological substances or matter in water?
A. Contaminants C. Pollutants
B. Chemicals D. None of the above

7. Which of the following for arsenic is zero?
A. Standard C. Safe Drinking Water Act limit
B. MCLG D. None of the above

8. Based on the MCLG, EPA has set an enforceable regulation for arsenic, called a maximum contaminant level, at?
A. Zero C. 0.010 mg/L or 10 ppb
B. 0.050 mg/L or 1.0 ppb D. None of the above

9. Which of the following are set as close to the health goals as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants?
A. MCLs C. ppb
B. MCLG D. None of the above

10. The main uses of _____ is for strengthening alloys of copper and especially lead.
A. Alloys of copper C. Metallic arsenic
B. Inorganic arsenic D. None of the above

11. Arsenic is a common n-type dopant in semiconductor electronic devices, and the optoelectronic compound of this missing term is the most common semiconductor in use after doped silicon.
A. Gallium arsenide C. Trioxide
B. Arsenic alloys D. None of the above

12. Arsenic and its compounds, especially of this missing term are used in the production of pesticides, herbicides, and insecticides. These applications are declining, however.
A. Gallium arsenide C. Trioxide
B. Arsenic alloys D. None of the above

13. Which of the following represents a groundwater problem that affects millions of people across the world?
A. The trioxide contamination C. Hydrogen contamination
B. Arsenic contamination D. None of the above

14. Arsenic, a naturally occurring element, is found throughout the environment; for most people?
A. A naturally occurring element C. Food is the major source of exposure
B. Inorganic arsenic D. None of the above

15. Acute high-level inhalation exposure to arsenic dust or fumes has resulted in gastrointestinal effects; central and peripheral nervous system disorders have occurred in workers acutely exposed to?
A. The Metalloid C. Inorganic arsenic
B. Arsenic and hydrogen D. None of the above

16. Chronic (long-term) inhalation exposure to this missing term in humans is associated with irritation of the skin and mucous membranes.
A. The Metalloid C. Inorganic arsenic
B. Arsenic and hydrogen D. None of the above

17. Chronic oral exposure has resulted in gastrointestinal effects, anemia, peripheral neuropathy, skin lesions, hyperpigmentation, and liver or kidney damage in humans
A. True B. False

18. EPA has classified inorganic arsenic as a?
A. Group A, human carcinogen C. Group A, Exposures

B. Risk factor for type 2 diabetes D. None of the above

Arsine

19. EPA has not classified arsine for?
A. Body weight basis C. Exposures and risks for the fetus
B. Carcinogenicity D. None of the above

20. Which of the following require public water systems to monitor for arsenic at the entry point to the distribution system?
A. Drinking water regulations C. MCLG
B. MCLs D. None of the above

21. The Operator may want to test their distribution system water for arsenic to be sure that the water being delivered has arsenic levels below the?
A. MCLG C. Action level
B. MCL D. None of the above

22. If you decide to monitor your distribution system, consider testing for arsenic at locations where the settling and accumulation of iron solids or pipe scales are likely (i.e., areas with cast iron pipe, ductile iron pipe, or galvanized iron pipe).
A. True B. False

23. A change in the taste, odor or appearance of the water at _____may be the first indication of an arsenic problem.
A. Pipe scales C. Customers' taps
B. The distribution system D. None of the above

24. Which of the following to consider when monitoring, depending on your arsenic treatment technology, include iron, pH, manganese, alkalinity, and aluminum?
A. Arsenic acid in water C. Some water quality parameters
B. Readily soluble in water D. None of the above

25. The current drinking water standard or Maximum Contaminant Level set by the U.S. Environmental Protection Agency is 0.010 mg/L or parts per million, this is equivalent to?
A. 50 ppb to 10 ppb C. 10 ug/L (micrograms per liter) or 10 ppb
B. 0.010 mg/L or 100 ppb D. None of the above

26. In 2001, the U.S. Environmental Protection Agency (EPA) reduced the regulatory MCL from _____ on the basis on bladder and lung cancer risks.
A. 50 ppb to 10 ppb C. 10 ug/L (micrograms per liter) or 10 ppb
B. 0.010 mg/L or 100 ppb D. None of the above

27. Long term exposure to drinking water containing arsenic at levels higher than this term increases the chances of getting cancer, while for lower arsenic water levels the chances are less.
A. 50 ppb to 10 ppb C. 10 ug/L (micrograms per liter) or 10 ppb
B. 10 ppb D. None of the above

28. If your water has arsenic levels above this term, you should obtain drinking water from another source or install a home treatment device.
A. 50 ppb to 10 ppb C. 10 ug/L (micrograms per liter) or 10 ppb
B. 10 ppb D. None of the above

29. Concentrations above this term will increase the risk of long-term or chronic health problems, the higher the level and length of exposure.
A. 50 ppb to 10 ppb C. 10 ug/L (micrograms per liter) or 10 ppb
B. 10 ppb D. None of the above

30. Children are at greater risk (to any agent in water) because of their greater water consumption on a per unit?
A. Body weight basis C. Exposures and risks
B. Risk factor for type 2 diabetes D. None of the above

31. Pregnant women may wish to reduce _____ because arsenic has been found at low levels in mother's milk and will cross the placenta, increasing exposures and risks for the fetus.
A. Arsenic exposures C. Exposures and risks for the fetus
B. Risk factor D. None of the above

32. If your water has arsenic levels above this term, you should immediately stop drinking the water until you can either obtain water from another source or install and maintain treatment.
A. 10 ppb C. 00.10 mg/L or 100 ppb
B. 200 ppb D. None of the above

Physical Characteristics
33. The three most common arsenic allotropes are metallic gray, yellow and _____, with gray being the most common.
A. Black arsenic C. Phosphorus acid
B. Arsenates D. None of the above

34. Which of the following is brittle and has a relatively low Mohs hardness of 3.5?
A. Arsenates C. Gray arsenic
B. Solid yellow arsenic D. None of the above

35. Nearest and next-nearest neighbors form this term, with the three atoms in the same double-layer being slightly closer than the three atoms in the next.
A. Arsenic acid C. A distorted octahedral complex
B. Alloy-like intermetallic compounds D. None of the above

36. Solid yellow arsenic is produced by rapid cooling of arsenic vapor, As_4. It is rapidly transformed into this term by light.
A. Arsenates C. Gray arsenic
B. Solid yellow arsenic D. None of the above

37. Which of the following is similar in structure to red phosphorus?
A. Synthetic arsenates C. Alloy-like intermetallic compounds
B. Black arsenic D. None of the above

Isotopes

38. Naturally occurring _____ is composed of one stable isotope.

A. Arsenic
C. Phosphorus acid
B. Solid yellow arsenic
D. None of the above

Chemistry

39. When heated in air, arsenic oxidizes to arsenic trioxide; the fumes from this reaction have an odor resembling garlic odor and can be detected on striking arsenide minerals such as with this term with a hammer.

A. Arsenic acid
C. Arsenic oxidizes to arsenic trioxide
B. Arsenopyrite
D. None of the above

40. Arsenic along with some arsenic compounds sublimes upon heating at atmospheric pressure, converting directly to a gaseous form without an intervening liquid state at 614 °C.

A. True
B. False

41. Arsenic makes arsenic acid with concentrated nitric acid, arsenious acid with dilute nitric acid, and _____ with concentrated sulfuric acid.

A. Synthetic arsenates
C. Alloy-like intermetallic compounds
B. Arsenic trioxide
D. None of the above

Compounds

42. Arsenic compounds resemble in some respects those of _____, which occupies the same group (column) of the periodic table.

A. Phosphorus
C. Phosphorus acid
B. Solid yellow arsenic
D. None of the above

43. The most common oxidation states for arsenic are: −3 in the arsenides, such as alloy-like intermetallic compounds; and +3 in the arsenites, arsenates (III), and?

A. Synthetic arsenates
C. Alloy-like intermetallic compounds
B. Most organoarsenic compounds
D. None of the above

44. Which of the following bonds readily to itself as seen in the square As3−4 ions in the mineral skutterudite?

A. Arsenic
C. Phosphorus acid
B. Gray arsenic
D. None of the above

Inorganic

45. Arsenic forms colorless, odorless, crystalline oxides As_2O_3 ("_____") and As_2O_5, which are hygroscopic and readily soluble in water to form acidic solutions.

A. Gray arsenic
C. Arsenic oxidizes to arsenic trioxide
B. White arsenic
D. None of the above

46. Arsenic (V) acid is a weak acid, its salts are called?

A. Gray arsenic
C. Paris Green
B. White arsenic
D. None of the above

47. Synthetic arsenates include this term, calcium arsenate, and lead hydrogen arsenate.
A. Gray arsenic C. Paris Green
B. White arsenic D. None of the above

48. The protonation steps between the arsenate and arsenic acid are similar to those between?
A. Phosphate and phosphoric acid C. Sulfur compounds
B. Arsenous acid D. None of the above

49. Unlike phosphorus acid, this term is genuinely tribasic, with the formula $As(OH)_3$.
A. Phosphate and phosphoric acid C. Sulfur compounds
B. Arsenous acid D. None of the above

50. A broad variety of this term of arsenic are known.
A. Phosphate and phosphoric acid C. Sulfur compounds
B. Arsenous acid D. None of the above

51. In which of the following, arsenic has a formal oxidation state of +2 in As_4S_4, which features As-As bonds so that the total covalency of As is still three?
A. As_4S_{10} C. Phosphorus acid
B. As_2S_{12} D. None of the above

Alloys
52. Arsenic is used as the group 5 element in the III-V semiconductors_____, indium arsenide, and aluminum arsenide.
A. Cadmium arsenide C. Gallium arsenide
B. Arsenic alloys D. None of the above

53. Other arsenic alloys include the II-IV semiconductor?
A. Cadmium arsenide C. Gallium arsenide
B. Arsenic alloys D. None of the above

Health Hazard Information
54. While arsenic levels may fluctuate over time, what is most significant from the standpoint of _____ is long-term exposure.
A. Pregnancy C. Exposures and risks for the fetus
B. Cancer risk D. None of the above

55. For water systems in the 25 states that reported arsenic data to the EPA, we have calculated _____ estimates of average long-term levels: one is a very conservative estimate, the other our best estimate, based on what we believe to be the most reasonable analytical techniques.
A. 10 C. 5
B. 2 D. None of the above

Arsenic Diabetes

56. New research findings from the National Health and Nutrition Examination Survey suggest that exposure to levels of arsenic commonly found in drinking water may be a risk factor for?

A. Body weight
B. Type 2 diabetes
C. Exposures and risks for the fetus
D. None of the above

57. The findings suggest that millions of Americans may be at increased _____ based on the level of arsenic in their drinking water.

A. Risk factor for type 2 diabetes
B. Prevalence of type 2 diabetes
C. Cancer risk is long-term exposure
D. None of the above

58. Data on the nearly 800 participants in the study for which urinary arsenic concentrations were available, indicated that urine levels of arsenic were significantly associated with the?

A. Body weight basis
B. Prevalence of type 2 diabetes
C. Exposures and risks for the fetus
D. None of the above

59. Which of the following in drinking water at concentrations higher than 100 parts per million has been linked to type 2 diabetes in studies that took place in Taiwan, Mexico, and Bangladesh?

A. Arsenic
B. Arsenic alloys
C. Inorganic arsenic
D. None of the above

60. Animal studies have shown that arsenic affects the production of glucose, insulin secretion and can cause insulin resistance.

A. True
B. False

61. The researchers estimate that about 13 million Americans live in areas where public water systems exceed the?

A. EPA standard
B. Action level
C. MCLG
D. None of the above

62. The current findings reinforce the need to evaluate the role of arsenic in diabetes development in prospective epidemiologic studies conducted in populations exposed to a wide range of levels of?

A. Arsenic
B. Arsenic alloys
C. Organic arsenic
D. None of the above

Acute Effects:
Inorganic Arsenic

63. Which of the following of workers to high levels of arsenic dusts or fumes has resulted in gastrointestinal effects?

A. Acute exposure
B. Acute inhalation exposure
C. Acute arsine exposure
D. None of the above

64. Acute oral exposure to inorganic arsenic, at doses of approximately 600 micrograms per kilogram body weight per day or higher in humans, has resulted in death.

A. 60
B. 6,000
C. 600
D. None of the above

65. Which of the following type of exposure to lower levels of inorganic arsenic has resulted in effects on the gastrointestinal tract, central nervous system, cardiovascular system, liver, kidney, and blood.
A. Acute C. Acute oral
B. Oral D. None of the above

66. Acute animal tests in rats and mice have shown inorganic arsenic to have?
A. Acute exposure C. Moderate to high acute toxicity
B. Acute inhalation exposure D. None of the above

Arsine
67. Acute inhalation exposure to arsine by humans has resulted in death; it has been reported that a half-hour exposure to 25 to 50 parts per million can be lethal?
A. 15 to 30 C. 25 to 70
B. 25 to 50 D. None of the above

68. The major effects from _____ in humans include headaches, vomiting, abdominal pains, hemolytic anemia, hemoglobinuria, and jaundice; these effects can lead to kidney failure.
A. Acute animal tests C. Acute arsine exposure
B. Acute inhalation exposure D. None of the above

69. Arsine has been shown to have extreme acute toxicity from?
A. Acute exposure C. Acute animal tests
B. Acute inhalation exposure D. None of the above

Chronic Effects (Non-cancer):
Inorganic Arsenic
70. Which of the following to inorganic arsenic in humans is associated with irritation of the skin and mucous membranes?
A. Chronic oral exposure C. Chronic inhalation exposure
B. Oral animal studies D. None of the above

71. Which of the following to inorganic arsenic in humans has resulted in gastrointestinal effects, anemia, peripheral neuropathy, skin lesions, hyperpigmentation, gangrene of the extremities, vascular lesions, and liver or kidney damage?
A. Chronic oral exposure C. Ingested inorganic arsenic
B. Chronic inhalation exposure D. None of the above

72. No _____ studies have been performed in animals for any inorganic arsenic compound.
A. Human C. Chronic inhalation exposure
B. Oral animal D. None of the above

73. Some studies have suggested that this term is an essential dietary nutrient in goats, chicks, and rats.
A. Arsenic C. Inorganic arsenic
B. Arsenic alloys D. None of the above

Reproductive/Developmental Effects:
Inorganic Arsenic

74. Several studies have suggested that women who work in, or live near, metal smelters may have higher than normal spontaneous abortion rates, and their children may exhibit lower than normal birth weights, these studies are limited because they were designed to evaluate the effects of smelter pollutants in general, and are not specific for?

A. Organic arsenic
C. Inorganic arsenic
B. Arsenic alloys
D. None of the above

75. Ingested _____ can cross the placenta in humans, exposing the fetus to the chemical.

A. Organic arsenic
C. Inorganic arsenic
B. Arsenic alloys
D. None of the above

76. Oral animal studies have reported this term at very high doses to be fetotoxic and to cause birth defects.

A. Organic arsenic
C. Inorganic arsenic
B. Arsenate
D. None of the above

Arsine

77. Human studies have indicated higher than expected spontaneous abortion rates in women in the microelectronics industry who were exposed to arsine. However, these studies have several limitations, including small sample size and exposure to this missing term in addition to arsine.

A. Arsine
C. Arsenate
B. Arsenic alloys
D. None of the above

Cancer Risk: Inorganic arsenic

78. Which of the following studies have reported inorganic arsenic exposure to be strongly associated with lung cancer?

A. Chronic oral exposure
C. Human, inhalation
B. Oral animal
D. None of the above

79. Which of the following in humans has been associated with an increased risk of nonmelanoma skin cancer and also to an increased risk of bladder, liver, and lung cancer?

A. Chronic oral exposure
C. Ingested inorganic arsenic
B. Acute exposure
D. None of the above

80. Which of the following have not associated inorganic arsenic exposure via the oral route with cancer, and no cancer inhalation studies have been performed in animals for inorganic arsenic?

A. Acute animal tests
C. Animal studies
B. Acute inhalation exposure
D. None of the above

81. EPA has classified this term as a Group A, human carcinogen.

A. Arsine
C. Inorganic arsenic
B. Arsenic alloys
D. None of the above

Arsenic Applications
Agricultural

82. The toxicity of arsenic to insects, bacteria and fungi led to its use as a wood preservative. In the 1950s a process of treating wood with _____ was invented, and for decades this treatment was the most extensive industrial use of arsenic.
A. Chromated copper arsenate C. Organic arsenic
B. Arsenic alloys D. None of the above

83. Which of the following was a common insecticide on fruit trees, but contact with the compound sometimes resulted in brain damage among those working the sprayers?
A. Organic arsenic C. Lead hydrogen arsenate
B. Arsenic alloys D. None of the above

84. Which of the following and disodium methyl arsenate (DSMA) – less toxic organic forms of arsenic – have replaced lead arsenate in agriculture?
A. Arsphenamine C. Fowler's solution
B. Monosodium methyl arsenate (MSMA) D. None of the above

85. Which of the following is still added to animal food, in particular in the US as a method of disease prevention and growth stimulation?
A. Roxarsone C. Fowler's solution
B. Arsenic D. None of the above

86. The Poison-Free Poultry Act of 2009 proposes to ban the use of _____ in industrial swine and poultry production.
A. Roxarsone C. Less toxic organic forms of arsenic
B. Fowler's solution D. None of the above

87. Alpharma, a subsidiary of Pfizer Inc., which produces _____ and has voluntarily suspended sales of the drug in response to studies showing elevated levels of arsenic in treated chickens.
A. Roxarsone C. Less toxic organic forms of arsenic
B. Fowler's solution D. None of the above

Medical Use

88. During the 18th, 19th, and 20th centuries, a number of arsenic compounds have been used as medicines, including?
A. Arsphenamine C. Fowler's solution
B. Arsenic D. None of the above

89. Arsphenamine as well as this term was indicated for syphilis and trypanosomiasis, but has been superseded by modern antibiotics.
A. Arsphenamine C. Fowler's solution
B. Neosalvarsan D. None of the above

90. Which of the following has been used in a variety of ways over the past 500 years, but most commonly in the treatment of cancer?
A. Arsenic trioxide C. Phosphorus acid
B. Arsenates D. None of the above

91. Which of the following was used as in treatment of psoriasis?
A. Arsphenamine C. Fowler's solution
B. Arsenic D. None of the above

92. Which of the following act as stimulants, and were once popular in small doses as medicine by people in the mid-18th century?
A. Roxarsone C. Soluble arsenic compounds
B. Arsphenamine D. None of the above

Alloys
93. Which of the following is for alloying with lead?
A. Metallic arsenic C. Phosphorus acid
B. Arsenic alloys D. None of the above

94. Which of the following is an important semiconductor material, used in integrated circuits?
A. Arsenic C. Gallium arsenide
B. Arsenic alloys D. None of the above

95. Circuits made from this term are much faster than those made in silicon.
A. GaAs C. Phosphorus acid
B. Arsenates D. None of the above

Bacteria
96. Under oxidative environmental conditions some bacteria use arsenite, which is oxidized to this term as fuel for their metabolism.
A. Arsphenamine C. Fowler's solution
B. Arsenate D. None of the above

97. The enzymes involved are known as?
A. Iron media C. Arsenate reductases (Arr)
B. Arsenic-rich particles D. None of the above

Arsenic Control Measures Can Affect Finished Water Quality
98. Some systems may need to adjust their finished water quality to address new concerns about?
A. Iron media C. Corrosion
B. Water chemistry D. None of the above

99. Which of the following due to using new sources, blending different source waters, or installing arsenic treatment are some of the factors that can affect distribution system water quality?
A. Water chemistry C. Arsenic-rich particles
B. Arsenic levels D. None of the above

100. In some cases, this may cause an increase in _____ in the distribution system or create simultaneous compliance issues with other drinking water regulations.
A. Iron media C. Arsenate reductases (Arr)
B. Arsenic levels D. None of the above

101. Water systems may also find deposits of this term in their storage tanks or at locations in their distribution system with low flows.
A. Water chemistry C. Arsenic-rich particles
B. Arsenic levels D. None of the above

102. This situation occurs primarily when this term used in treatment are released into the distribution system.
A. Iron media C. Arsenate reductases (Arr)
B. Arsenic-rich particles D. None of the above

Is Arsenic in your Storage Tank?
Is Your Ground Water System Installing Disinfection for Pathogen Control?
103. Water systems that disinfect their water should be aware of the possibility of an increase in arsenic concentrations in their distribution system, particularly if the water contains high concentrations of dissolved?
A. Dissolved iron C. Aluminum arsenide
B. Arsenic alloys D. None of the above

104. When chlorinated, the dissolved iron forms particles on which arsenic can accumulate. As a result, high arsenic concentrations may occur in distribution system water even if arsenic concentrations in the raw water are below the?
A. MCL C. 0.010 mg/L or 10 ppb
B. MCLG D. None of the above

105. This happened to a small community water system in the Midwest that began chlorinating water from a series of wells that had raw water arsenic levels between 0.003 and 0.008 mg/L and iron concentrations up to?
A. 10 ppb C. 00.10 mg/L or 100 ppb
B. 0.4 mg/L D. None of the above

106. Soon after chlorination begins, the system received intermittent _____ complaint from its customers with increasing frequency across the distribution system.
A. Colored-water C. Toxic waste
B. Arsenic exposure D. None of the above

107. Which of the following collected from several representative locations throughout the service area had a reddish-brown color and contained particles?
A. Arsenic poisoning C. Source water
B. Samples D. None of the above

108. A metals analysis showed high levels of copper and iron oxides in the finished water, along with arsenic concentrations approaching?
A. 50 ppb to 10 ppb C. 5 mg/L
B. 0.4 mg/L D. None of the above

109. Doctors and health care professionals were notified of the situation and instructed to watch for signs of?
A. Chronic oral exposure C. Chronic inhalation exposure
B. Arsenic poisoning D. None of the above

110. Researchers found that chlorinating the water caused the formation of?
A. Ferri-hydroxide solids C. Toxic waste disposal problem
B. Organic compound arsenobetaine D. None of the above

Biomethylation
111. Inorganic arsenic and its compounds, upon entering the food chain, are progressively metabolized through?
A. Samples C. Progressively metabolized
B. A process of methylation D. None of the above

112. There is little danger in eating fish because this term is nearly non-toxic.
A. Arsenic compound C. Toxic waste disposal problem
B. Arsenic levels D. None of the above

Arsenic Environmental Issues
Arsenic Control Measures Can Affect Finished Water Quality
113. Public water systems may need to adjust their finished water quality to address new concerns about?
A. Corrosion C. Arsenic alloys
B. Arsenates D. None of the above

114. Changes in water chemistry due to using new sources, blending different source waters, or installing arsenic treatment are some of the factors that can affect distribution system water quality. In some cases, this may cause an increase in arsenic levels in the distribution system or create simultaneous compliance issues with other drinking water regulations.
A. True B. False

Occurrence in drinking water
115. Parts of New England, Michigan, Wisconsin, Minnesota and the Dakotas are also known to have significant concentrations of?
A. Arsenic in ground water C. Arsenic-rich particles
B. Arsenic levels D. None of the above

116. Increased levels of skin cancer have been associated with arsenic exposure in Wisconsin, even at levels below this term drinking water standard, although this link has not been proven.
A. 100 ppb C. 10 part per billion
B. 0.4 mg/L D. None of the above

117. According to a recent film funded by the US Superfund, millions of private wells have this term levels.
A. Arsenic poisoning C. Blending different source waters
B. Unknown arsenic D. None of the above

118. Low-level exposure to arsenic at concentrations found commonly in US drinking water compromises the initial immune response to this missing term according to NIEHS-supported scientists.
A. Acute exposure C. Acute oral exposure
B. H1N1 or swine flu infection D. None of the above

Wood Preservation in the US

119. The direct or indirect ingestion of wood ash from burnt CCA lumber has caused fatalities in animals and serious poisonings in humans; the lethal human dose is approximately 20 grams of ash.

A. True B. False

Water Purification Solutions

Small-scale water treatment

120. A simpler and less expensive form of arsenic removal is known as this term using three pitchers containing cast iron turnings and sand in the first pitcher and wood activated carbon and sand in the second.

A. Sono arsenic filter C. Progressively forward filter
B. Arsenic feed D. None of the above

121. These systems are in use and can last for years while avoiding this term disposal problem inherent to conventional arsenic removal plants.

A. Toxic waste C. Arsenic levels
B. Arsenic exposure D. None of the above

122. In the United States small "under the sink" units have been used to remove arsenic from drinking water. This option is called?

A. Ion Exchange C. Reverse osmosis and electrodialysis
B. Point of use D. None of the above

123. Which of the following and activated alumina have been considered but not commonly used?

A. Ion exchange C. Domestic treatment
B. Concrete stabilization D. None of the above

Arsenic Large-scale water treatment

124. The effectiveness of any method depends on the biological makeup of a particular water supply.

A. True B. False

125. Some large utilities with multiple water supply wells could shut down those wells with high iron concentrations, and produce only from wells or surface water sources that meet the arsenic action level

A. True B. False

126. The aqueous chemistry of _____ is complex, and may affect the removal rate that can be achieved by a particular process.

A. Arsenic C. Phosphorus acid
B. Solid yellow arsenic D. None of the above

127. Small utilities with only a few wells, may have no available water supply that meets the arsenic_____.

A. Long-term column performance C. Domestic treatment
B. Standard D. None of the above

128. Coagulation/filtration also known as this term removes arsenic by coprecipitation and adsorption using iron coagulants.
A. Traditional anion exchange C. Flocculation
B. Domestic treatment D. None of the above

129. Which of the following using alum is already used by some utilities to remove suspended solids and may be adjusted to remove arsenic?
A. Traditional anion exchange C. Coagulation/filtration
B. Domestic treatment D. None of the above

130. The toxic arsenic sludge are disposed of by?
A. Activated alumina C. Point of use
B. Concrete stabilization D. None of the above

131. Which of the following filters the water through a granular medium containing ferric oxide?
A. Activated alumina C. Point of use
B. Iron oxide adsorption D. None of the above

132. Which of the following eventually becomes saturated, and must be replaced?
A. Ion Exchange C. Reverse osmosis and electrodialysis
B. Iron oxide medium D. None of the above

133. Which of the following columns connected to shallow tube wells in India and Bangladesh have successfully removed both As(III) and As(V) from groundwater for decades?
A. Activated alumina C. Point of use
B. Concrete stabilization D. None of the above

134. Which of the following performance has been possible through the efforts of community-elected water committees that collect a local water tax for funding operations?
A. Ion Exchange C. Reverse osmosis and electrodialysis
B. Long-term column D. None of the above

135. Which of the following has long been used as a water-softening process?
A. Ion Exchange C. Reverse osmosis and electrodialysis
B. Activated alumina D. None of the above

136. Which of the following is effective in removing As(V), but not As (III), or arsenic trioxide?
A. Traditional anion exchange C. One of these methods to reduce total dissolved solids
B. Treatment trains D. None of the above

137. Which of the following removal of arsenic requires a trained operator to maintain the column?
A. Traditional anion exchange C. Ion exchange
B. Precipitation/ coprecipitation and filtration D. None of the above

138. Both Reverse osmosis and _____ can remove arsenic with a net ionic charge.
A. Activated alumina C. Point of use
B. Electrodialysis D. None of the above

139. Some utilities presently use one of these methods to reduce total dissolved solids and therefore improve_____.
A. Taste C. Precipitation
B. Influent and effluent concentrations D. None of the above

Subterranean Arsenic Removal (SAR) Technology
140. The oxidation zone created by aerated water boosts the activity of _____ which can oxidize arsenic from +3 to +5 state SAR Technology.
A. Arsenic C. Arsenic-oxidizing microorganisms
B. Arsenic alloys D. None of the above

141. No chemicals are used and _____ is produced during operational stage since iron and arsenic compounds are rendered inactive in the aquifer itself.
A. Almost no sludge C. Gray arsenic
B. Solid yellow arsenic D. None of the above

The Hungarian Solution
142. Hungarian engineer László Schremmer has recently discovered that by the use of this term it is possible to reduce the arsenic content of water to 3 microgram/liter.
A. Traditional anion exchange C. Chaff-based filters
B. Influent and effluent concentrations D. None of the above

Arsenic Can Build Up on and Release in Pipes and Storage Tanks
143. Which of the following may also find deposits of arsenic-rich particles in their storage tanks or at locations in their distribution system with low flows?
A. Regulatory cleanup levels C. Water Systems
B. Storage tanks D. None of the above

144. If the flow is increased or a storage tank is drawn down to a low level, these arsenic-rich particles can get stirred up and conveyed to consumers' taps.
A. True B. False

145. Public water systems with arsenic in their raw water may find that scales on pipes and other components in their _____contain relatively high arsenic concentrations.
A. Water C. Distribution systems
B. Meters D. None of the above

146. Because iron is so effective at binding with arsenic, corrosion deposits can have high concentrations of?
A. Arsenic solids C. Aluminum arsenide
B. Arsenic alloys D. None of the above

Who Needs to Know about Arsenic Treatment Technologies?
147. Arsenic is a common inorganic element found broadly in the environment. It is in many industrial products, wastes, and wastewaters, and is a contaminant of concern at many remediation sites.
A. True B. False

148. Arsenic contaminated _____must be treated by removing Arsenic or immobilizing it.
A. Arsenates C. Soil, waste, and water
B. Arsenic alloys D. None of the above

149. Because arsenic readily changes valence states and reacts to form species, effective, long-term treatment of Arsenic can be simple.
A. True B. False

150. In some disposal environments Arsenic has leached from _____at high concentrations.
A. Arsenate C. Arsenic-bearing wastes
B. Arsenic alloys D. None of the above

151. Drinking water suppliers may need to add new treatment processes or retrofit existing treatment systems to meet the revised?
A. US drinking water guideline C. Arsenic level
B. MCL D. None of the above

Where Does Arsenic Come From?
152. Industrial products having arsenic include wood preservatives, paints, environment include mining and smelting operations; agricultural applications; burning of fossil fuels and wastes; pulp and paper production; cement manufacturing; and former agricultural uses of Arsenic.
A. True B. False

How Does Arsenic Chemistry Affect Treatment?
153. Arsenic is a metalloid or inorganic semiconductor that can form?
A. Valence state and chemical form C. Inorganic and organic compounds
B. Valence states of -3 and 0 D. None of the above

154. Which of the following of -3 and 0 occur only rarely in nature?
A. Valence state C. Inorganic and organic compounds
B. Chemical form D. None of the above

155. The toxicity and mobility of arsenic varies with its?
A. Valence state and chemical form C. Inorganic and organic compounds
B. Valence states of -3 and 0 D. None of the above

156. Which of the following are the dominant species in surface water and sea water, and organic arsenic species can be found in natural gas and shale oil?
A. Arsenate C. Gray arsenic
B. Arsenite and arsenate D. None of the above

157. Which of the following exhibit varying degrees of toxicity and solubility?
A. Groundwater C. Chemical compounds containing arsenic
B. Arsenic levels D. None of the above

158. Arsenic readily changes this term in the environment.
A. Valence state and chemical form
B. Toxicity and mobility of arsenic
C. Inorganic and organic compounds
D. None of the above

159. Which of the following can also affect the mobility of arsenic in the environment?
A. Long-term column performance
B. Adsorption-desorption reactions
C. Domestic treatment
D. None of the above

160. The successful express treatment and long-term disposal of arsenic requires an understanding of arsenic chemistry and the disposal environment.
A. True B. False

How Often Does Arsenic Occur in Drinking Water?
161. Which of the following is a fairly common environmental contaminant?
A. Arsenic
B. Arsenates
C. Phosphorus acid
D. None of the above

162. The levels of arsenic are typically higher in?
A. Arsenic exposure
B. Sea water
C. Groundwater sources
D. None of the above

How Often Does Arsenic Occur at Hazardous Waste Sites?
163. Hazardous waste sites fall under several clean-up programs, such as this term along with corrective actions, and state cleanup programs.
A. EPA C. RCRA
B. OSHA D. None of the above

Different Arsenic Treatment Technologies
Number of Applications of Arsenic Treatment Technologies at Superfund Sites
164. Information on the application of groundwater pumps and treatment technologies, including precipitation/coprecipitation, this term, adsorption, and ion exchange, is based on available data and is not comprehensive.
A. Activated alumina
B. Membrane filtration
C. Point of use
D. None of the above

Treatment Trains
165. Treatment trains consist of two or more technologies used together, either integrated into a single process or operated as?
A. Traditional anion exchange
B. Influent and effluent concentrations
C. A series of treatments in sequence
D. None of the above

166. A common treatment train used for arsenic in water includes an oxidation step to change arsenic from As(III) to its less soluble As(V) state, followed by this term and filtration to remove the precipitate.
A. Treatment trains
B. Influent and effluent concentrations
C. Precipitation/ coprecipitation
D. None of the above

167. Which of the following are employed when one technology alone is not capable of treating all of the contaminants?
A. Traditional anion exchange
B. Trains
C. One of these methods to reduce total dissolved solids
D. None of the above

168. Which of the following terms, where available, often were provided for the entire train, and not the individual components?
A. Trains
B. Influent and effluent concentrations
C. Precipitation/ coprecipitation and filtration
D. None of the above

169. Which of the following is most commonly used to treat organic contaminants?
A. Activated alumina
B. Activated carbon adsorption
C. Point of use
D. None of the above

What Technologies Are Used Most Often to Treat Arsenic?

170. The most frequently used technology for soil and waste containing arsenic is?
A. Solidification/stabilization
B. Vitrification
C. The Rust treatment technologies
D. None of the above

171. The available data show that this technology can effectively meet regulatory cleanup levels, is commercially available to treat both soil and waste, is usually less expensive, and generates a residual that typically does not require?
A. Iron removal treatment
B. Vitrification
C. Further treatment prior to disposal
D. None of the above

172. Other arsenic treatment technologies for soil and waste are typically used for?
A. Regulatory cleanup levels
B. Iron removal treatment
C. Specific applications
D. None of the above

173. Vitrification may be used when a combination of contaminants are present that cannot be effectively treated using?
A. Iron removal treatment
B. Solidification/stabilization
C. Relatively high arsenic concentrations
D. None of the above

174. Which of the following typically requires large amounts of energy, can be more expensive than S/S, and may generate off-gasses containing arsenic?
A. Regulatory cleanup levels
B. Vitrification
C. Iron removal treatment
D. None of the above

175. Which of the following is used primarily to treat soil. It is not applicable to all types of soil or to waste?
A. Soil washing/acid extraction
B. Organic extraction
C. Toxic waste extraction
D. None of the above

176. Which of the following has been used primarily to recycle arsenic from industrial wastes containing high concentrations of arsenic from metals refining and smelting operations?
A. Iron removal treatment
B. Vitrification
C. Pyrometallurgical treatment
D. None of the above

177. _____treats soil in place, eliminating the need to excavate soil.
A. In situ soil flushing C. Lime softening
B. Clarification and filtration D. None of the above

178. Which of the following is frequently used to treat arsenic contaminated water, and is capable of treating a wide range of influent concentrations to the revised MCL for arsenic?
A. Precipitation/ coprecipitation C. Best available technologies (BATs)
B. Clarification and filtration D. None of the above

179. The effectiveness of precipitation/ coprecipitation technology is less likely to be reduced by characteristics and contaminants other than arsenic, compared to other water treatment technologies.
A. True B. False

180. Which of the following is more cost effective at a large scale where labor costs can be spread over a larger amount of treated water produced?
A. Precipitation/ coprecipitation C. Clarification and filtration
B. Lime softening D. None of the above

181. The effectiveness of this term for arsenic treatment is more likely than precipitation/coprecipitation to be affected by characteristics and contaminants other than arsenic.
A. Adsorption and ion exchange C. Lime softening
B. Clarification and filtration D. None of the above

EPA Water Treatment Processes Section
182. Treating your water to reduce arsenic will be necessary if more cost-effective alternatives are not available. EPA has identified this term and small system compliance technologies for removing arsenic from drinking water.
A. Precipitation/ coprecipitation C. Best available technologies (BATs)
B. Clarification and filtration D. None of the above

183. BATs are technologies that have proven effective for large systems, and this term are technologies that are effective and affordable for small systems.
A. SSCTs C. Lime softening
B. Clarification and filtration D. None of the above

184. Systems can use technologies not listed as _____ if they are effective.
A. SSCTs C. BATs or SSCTs
B. Clarification and filtration D. None of the above

185. Which of the following if approved by the State, would allow the system to supply water with an arsenic level above the MCL for a certain period of time?
A. A general variance C. An exception
B. An exclusion D. None of the above

186. EPA anticipates that most small systems will use this term, reverse osmosis POU devices, or modified lime softening.
A. Clarification and filtration C. Concrete stabilization
B. Activated alumina D. None of the above

Activated Alumina
187. When AA is exhausted it is simply disposed of and replaced with fresh?
A. Activated alumina(AA) C. Ion Exchange
B. Concrete stabilization D. None of the above

Reverse Osmosis
188. Which of the following can treat water containing up to 0.160 mg/L of arsenic?
A. Activated alumina C. Electrodialysis
B. Reverse osmosis D. None of the above

Modified Lime Softening
189. The addition of lime to water causes calcium and magnesium to form solid particles, which can then be removed by?
A. A general variance C. Lime softening
B. Clarification and filtration D. None of the above

190. Which of the following is very expensive and water systems are unlikely to install this technology only for arsenic removal?
A. Precipitation/ coprecipitation C. Lime softening
B. Clarification and filtration D. None of the above

191. Which of the following can treat water containing up to 0.080 mg/L of arsenic?
A. Modified lime softening C. Lime softening
B. Clarification and filtration D. None of the above

Point-of-Use Units
192. Under the Arsenic Rule, systems have this approach involves system-installed and maintained _____on a single tap in each customer's household.
A. Ion Exchange C. Concrete stabilization
B. POU devices D. None of the above

193. Which of the following the EPA is developing guidance on how to implement a POU compliance strategy.
A. Activated alumina C. Point-of-use reverse osmosis treatment unit
B. Concrete stabilization D. None of the above

Model of a Precipitation/Coprecipitation System
194. Which of the following has been the most frequently used method to treat arsenic contaminated water, including groundwater, surface water, leachate, mine drainage, drinking water, and wastewater?
A. Traditional anion exchange C. Coagulation/filtration
B. Precipitation/coprecipitation D. None of the above

195. Which of the following uses chemicals to transform dissolved contaminants into an insoluble solid?
A. Traditional anion exchange C. Coagulation/filtration
B. Precipitation D. None of the above

196. Colloidal or suspended contaminants become enmeshed with other precipitated species, or are removed through processes such as?
A. Traditional anion exchange C. Coagulation and flocculation
B. Concrete stabilization D. None of the above

197. The precipitated/coprecipitated solid is then removed from the liquid phase by?
A. Traditional anion exchange C. Clarification or filtration
B. Concrete stabilization D. None of the above

198. Which of the following usually involves pH adjustment and addition of a chemical precipitant or coagulant; it can also include addition of a chemical oxidant?
A. Traditional anion exchange C. Coagulation/filtration
B. Precipitation/coprecipitation D. None of the above

199. Oxidation of arsenic to its less soluble As(V) state can increase the effectiveness of _____, and can be done as a separate pretreatment step or as part of the precipitation process.
A. Pretreatment C. Precipitation/coprecipitation
B. Clarification or filtration D. None of the above

200. Which of the following that oxidize As(III) to As(V) include ozonation, photo oxidation?
A. Pretreatment processes C. Precipitation/coprecipitation processes
B. Clarification or filtration D. None of the above

201. Which of the following is commonly used to remove the solid precipitate. Precipitation/coprecipitation is frequently used to treat water contaminated with metals?
A. Oxidation of arsenic C. An active ex situ treatment technology
B. Clarification or filtration D. None of the above

202. _____is frequently used to treat water contaminated with metals.
A. Pretreatment processes C. Precipitation/coprecipitation processes
B. Clarification or filtration D. None of the above

Precipitation/Coprecipitation Chemistry
Precipitation Reactions
203. Which of the following occur all around us?
A. Traditional anion exchange C. Coagulation/filtration
B. Precipitation reactions D. None of the above

204. Another example is a kidney stone, it is nothing more than a precipitate - often of _____ions and oxalates?
A. Sodium C. Calcium
B. Potassium D. None of the above

Complex

205. The chemistry of _____ is often complex, and depends upon a variety of factors, including the speciation of arsenic, the chemical precipitants used and their concentrations.

A. Long-term column performance C. Domestic treatment
B. Precipitation/coprecipitation D. None of the above

Factors Affecting Precipitation/Coprecipitation Performance

206. Valence state of arsenic - The presence of this term of arsenic may reduce the removal efficiency.

A. Valence state and chemical form C. Soluble trivalent state
B. Toxicity and mobility of arsenic D. None of the above

207. Which of the following depends upon its valence state, pH, the specific arsenic compound, and the presence of other chemicals with which arsenic might react?

A. Solubility of arsenic C. Inorganic and organic compounds
B. Toxicity and mobility of arsenic D. None of the above

208. The optimal pH range for this term depends upon the waste treated and the specific treatment process.

A. Pretreatment processes C. Precipitation/coprecipitation
B. Clarification or filtration D. None of the above

209. Sulfite could decrease arsenic removal in processes using ferric chloride as a coagulant, while the presence of sodium or iron may increase the removal of arsenic in these processes

A. True B. False

Applicability, Advantages, and Potential Limitations

210. Which of the following is an active ex situ treatment technology designed to function with routine chemical addition and sludge removal?

A. Pretreatment processes C. Precipitation/coprecipitation
B. Clarification or filtration D. None of the above

211. Some sludge from the precipitation/coprecipitation of arsenic can be a hazardous waste and require additional treatment such as this term prior to disposal.

A. Solidification/stabilization C. An active ex situ treatment technology
B. Clarification or filtration D. None of the above

212. In the presence of other metals or contaminants, arsenic this term may also cause other compounds to precipitate, which can render the resulting sludge hazardous.

A. Pretreatment processes C. Precipitation/coprecipitation processes
B. Oxidation of arsenic D. None of the above

Factors Affecting Precipitation/Coprecipitation Costs

213. Type of chemical addition - The chemical added will affect costs. For example, calcium hypochlorite, is a less expensive oxidant than?

A. Pretreatment processes C. Potassium permanganate
B. Oxidation of arsenic D. None of the above

214. Chemical dosage - The cost generally increases with increased?
A. Sludge C. Additional treatment or disposal
B. Chemical addition D. None of the above

215. Larger amounts of chemicals added usually results in a larger amount of?
A. Sludge C. Additional treatment or disposal
B. Chemical addition D. None of the above

216. Treatment goal - Application could require additional treatment to meet stringent cleanup goals and/or effluent and?
A. Remove dissolved arsenic species C. Disposal standards
B. Additional treatment or disposal D. None of the above

217. Which of the following could be considered a hazardous waste and require additional treatment before disposal, or disposal as hazardous waste?
A. Precipitation/coprecipitation process C. Increased chemical addition
B. Effluent and disposal standards D. None of the above

Membrane Filtration for Arsenic
218. Which of the following can remove a wide range of contaminants from water?
A. Reverse osmosis (RO) C. Membrane filtration
B. Precipitation/coprecipitation D. None of the above

219. Its effectiveness is sensitive to a variety of untreated water contaminants and characteristics. It also produces a larger volume of residuals and tends to be more expensive than?
A. Reverse osmosis (RO) C. Other arsenic treatment technologies
B. Precipitation/coprecipitation D. None of the above

220. Therefore, it is used less frequently than precipitation/coprecipitation?
A. NF and RO C. Adsorption and ion exchange
B. The low pressure processes D. None of the above

221. Which of the following separates contaminants from water by passing it through a semi-permeable barrier or membrane?
A. Reverse osmosis (RO) C. Membrane filtration
B. Precipitation/coprecipitation D. None of the above

Technology Description and Principles
222. There are four types of membrane processes: this missing term, ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO).
A. Reverse osmosis (RO) C. Microfiltration (MF)
B. The low pressure processes D. None of the above

223. All four of these processes are _____ and are categorized by the size of the particles that can pass through the membranes or by the molecular weight cut off of the membrane.
A. Pressure-driven C. Arsenic removers
B. Low pressure processes D. None of the above

224. The force required to drive fluid across the membrane depends on the pore size; NF and RO require a relatively high pressure, while this term requires lower pressure.
A. NF and RO C. MF and UF
B. The low pressure processes D. None of the above

225. Which of the following primarily remove contaminants through physical sieving, and the high pressure processes through chemical diffusion across the permeable membrane?
A. Reverse osmosis (RO) C. The low pressure
B. The high pressure processes D. None of the above

226. Because arsenic species dissolved in water tend to have relatively low molecular weights, only _____ membrane processes are likely to effectively treat dissolved arsenic.
A. NF and RO C. MF and UF
B. The low pressure processes D. None of the above

227. Which of the following has been used with precipitation/coprecipitation to remove solids containing arsenic?
A. Reverse osmosis (RO) C. MF
B. NF and RO D. None of the above

Membrane filtration processes
228. Which of the following process is a separating process, in which a feed flow is divided into two flows, either gaseous or liquid?
A. Oxidation C. A membrane
B. High pressure processes D. None of the above

229. If the two phases are fluid, then we speak of?
A. MF is a low-pressure process C. Membrane fouling
B. Membrane filtration D. None of the above

230. The membrane itself forms a semi-permeable barrier through which some particles are transported faster than others, so that?
A. NF occurs C. High-pressure occurs
B. A separation occurs D. None of the above

231. The pressure driven membrane filtration processes are: microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and?
A. Reverse osmosis (RO) C. Membrane fouling
B. Oxidation D. None of the above

232. The smaller the pore size of the membranes, the higher the pressure needed to achieve separation. In the case of microfiltration and ultrafiltration, we speak of low-pressure processes, while this term are high-pressure processes.
A. Oxidation C. Nanofiltration and reverse osmosis
B. RO D. None of the above

233. Which of the following generates two treatment residuals from the influent waste stream: a treated effluent and a rejected waste stream of concentrated contaminants?
A. Membrane fouling C. MF
B. NF D. None of the above

234. The molecular weight cut off for this term ranges from 1 to 20,000, which is a significantly lower cut off than for NF membranes.
A. NF membranes C. High-pressure processes
B. RO membranes D. None of the above

235. The molecular weight cut off for these membranes ranges from approximately 150 to 20,000.
A. Adsorption C. MF
B. NF D. None of the above

236. NF is slightly less efficient than this term in removing dissolved arsenic from water.
A. Reverse osmosis (RO) C. Arsenic concentrations
B. The low pressure processes D. None of the above

Factors Affecting Membrane Filtration Performance
237. Suspended solids, high molecular weight, dissolved solids, organic compounds, and colloids - The presence of these constituents in feed stream may cause _____.
A. Pressure C. Membrane fouling
B. Adsorption of arsenic D. None of the above

238. Which of the following of the influent stream to convert As(III) to As(V) will increase arsenic removal?
A. Post oxidation C. High-pressure processes
B. Prior oxidation D. None of the above

239. pH may affect the adsorption of arsenic on the membrane by creating?
A. Adsorption of arsenic C. An electrostatic charge
B. Mechanical force D. None of the above

240. Temperature - Low influent stream temperatures decreases membrane flux. Increasing system pressure or increasing the membrane surface area may compensate for?
A. Oxidation C. Precipitation/ coprecipitation
B. Low influent stream temperature D. None of the above

241. Which of the following is a low-pressure process that primarily removes particles with a molecular weight above 50,000 or a particle size greater than 0.050 micrometers?
A. MF C. Membrane fouling
B. NF D. None of the above

242. The pore size of MF membranes is too large to effectively remove dissolved arsenic species, but MF can remove particulates containing arsenic and solids produced by?
A. Oxidation C. Precipitation/ coprecipitation
B. Low pressure processes D. None of the above

Media and Contaminants Treated

243. Which of the following can treat dissolved salts and other dissolved materials?

A. Membrane filtration
B. Additional treatment
C. Increased chemical addition
D. None of the above

Adsorption Treatment for Arsenic

244. Which of the following has been used to treat groundwater and drinking water containing arsenic?

A. Adsorption
B. Greensand
C. Precipitation/coprecipitation
D. None of the Above

245. Based on the information collected for this course, this technology typically can reduce arsenic concentrations to less than _____ and in some cases has reduced arsenic concentrations to below 0.010 mg/L.

A. 50 ppb to 10 ppb
B. 0.050 mg/L
C. 10 ug/L (micrograms per liter) or 10 ppb
D. None of the above

246. It is used less frequently than _____, and is most commonly used to treat groundwater and drinking water, or as a polishing step for other water treatment processes.

A. Adsorption
B. Greensand
C. Precipitation/coprecipitation
D. None of the above

247. _____, solutes (contaminants) concentrate at the surface of a sorbent, thereby reducing their concentration in the bulk liquid phase.

A. Adsorption
B. Greensand
C. Precipitation/coprecipitation
D. None of the above

248. The adsorption media is usually packed into?

A. Bulk liquid phase
B. Adsorption filter
C. A column
D. None of the above

249. When adsorption sites become filled, the column must be regenerated or disposed of and replaced with?

A. Bulk liquid phase
B. Adsorption sand
C. New media
D. None of the above

Technology Description and Principles

250. The primary removal mechanism in each process is adsorption. For example, greensand is made from?

A. Glauconite
B. Greensand
C. Precipitation/coprecipitation
D. None of the Above

251. Which of the following containing sand is treated with potassium permanganate, forming a layer of manganese oxides on the sand?

A. Bulk liquid phase
B. Glauconite
C. Greensand media
D. None of the above

252. As water passes through a greensand filtration bed, the $KMnO_4$ oxidizes As(III) to As(V), and As(V) adsorbs onto the greensand surface. In addition, arsenic is removed by this term, displacing species from the manganese oxide (presumably hydroxide ion and water.

A. Ion exchange
B. Iron-based adsorption media)
C. The regeneration process
D. None of the Above

253. When which of the following is exhausted, the greensand media must be regenerated or replaced?

A. Ion exchange
B. Activated carbon (AC)
C. KMnO4
D. None of the Above

254. Greensand media is regenerated with a solution of excess KMnO4.Greensand filtration is also known as?

A. Ion exchange
B. Iron-based adsorption media
C. Oxidation/filtration
D. None of the above

255. Which of the following is the sorbent most commonly used to remove arsenic from drinking water, and has been used for groundwater?

A. KMnO4
B. Activated alumina (AA)
C. Solution of surfactant
D. None of the above

256. The regeneration process desorbs the arsenic, the regeneration fluid most commonly used for AA treatment systems is?

A. A solution of sodium hydroxide
B. Iron-based adsorption media
C. Greensand media
D. None of the above

257. The most commonly used neutralization fluid is a solution of sulfuric acid. The regeneration and neutralization steps for _____ might produce a sludge because the alumina can be dissolved by the strong acids and bases used in these processes.

A. AA adsorption systems
B. Iron-based adsorption media
C. The regeneration process
D. None of the above

258. Which of the following is an organic sorbent that is commonly used to remove organic and metal contaminants from drinking water, groundwater, and wastewater?

A. Reduction
B. Activated carbon (AC)
C. Iron-based adsorption media
D. None of the above

259. The arsenic might not volatilize at the temperatures typically used in?

A. Ion exchange
B. Reduction
C. AC regeneration
D. None of the above

260. Iron-based adsorption media include this term, ferric hydroxide-coated newspaper pulp, ferric oxide, iron oxide-coated sand, sulfur-modified iron, and iron filings mixed with sand.

A. Greensand media
B. Activated carbon (AC)
C. Granular ferric hydroxide
D. None of the above

261. Processes that use these media typically remove arsenic using adsorption in combination with oxidation, precipitation/coprecipitation?
A. NF and RO C. Ion exchange or filtration
B. The low pressure processes D. None of the above

262. Which of the following uses adsorption and ion exchange with surface hydroxides to selectively remove arsenic from water?
A. Greensand media C. Iron oxide-coated sand
B. Activated carbon (AC) D. None of the above

263. The media requires periodic regeneration or disposal and replacement with new media. The regeneration process is similar to that used for _____, and consists of rinsing the media with a regenerating solution containing excess sodium hydroxide, flushing with water, and neutralizing with a strong acid, such as sulfuric acid.
A. AA C. The regeneration process
B. Activated carbon (AC) D. None of the above

264. Which of the following is prepared by treating zeolite with a solution of surfactant, such as hexadecyltrimethyl-ammonium bromide?
A. Ion exchange C. SMZ
B. Greensand media D. None of the above

Zeolite
265. The name zeolite is a general term for a stone like material that consist of this term with a large internal surface area of up to 1000 m²/g.
A. The optimal pH C. Crystalline metal-alumo-silicates
B. Zeolite D. None of the above

266. The word zeolite is of Greek origin and means – directly translated – ?
A. Adsorption C. Reduction
B. Boiling rock D. None of the above

267. More than 40 natural and 100 synthetic _____ are known.
A. Crystal lattices C. Molecular sieves
B. Zeolites D. None of the above

268. Even after several thousand adsorption/desorption cycles, the structural changes of this term are insignificant if the process parameters pressure and temperature do not exceed certain limits.
A. Crystal lattice C. Molecular sieves
B. Zeolites D. None of the above

269. The application diversity of zeolites is tremendous: they are applied as molecular sieves, as adsorbents, as catalysts in cracking of hydrocarbons in the pretro-chemical industry, as filler components in paper production and as?
A. Adsorption sponges C. Ion exchange material in detergents
B. Zeolites D. None of the above

270. The price, e.g. for this missing term is between 1.00 and 8.00 DM/kg, depending on the type and consistency of material delivered.
A. Adsorption C. Laundry detergent zeolite
B. Zeolites D. None of the above

Media and Contaminants Treated
271. Which of the following is frequently used to remove organic contaminants and metals from industrial wastewater?
A. Adsorption C. Ion exchange
B. Reduction D. None of the above

Summary of Performance Data
272. Which of the following treatment effectiveness can be evaluated by comparing influent and effluent contaminant concentrations?
A. Reduction C. Iron-based adsorption media
B. Adsorption D. None of the above

Factors Affecting Adsorption Performance
273. Fouling - The presence of suspended solids, organics, solids, silica, or mica, can cause fouling of this term's media.
A. Adsorption C. Ion exchange
B. Reduction D. None of the above

274. Arsenic oxidation state – _____ is more effective in removing As(V) than As(III).
A. Adsorption C. Reduction
B. Activated carbon (AC) D. None of the above

275. Flow rate - Increasing the rate of flow through this term can decrease the adsorption of contaminants.
A. The exchange medium C. Adsorption unit
B. Influent arsenic concentration D. None of the above

276. Wastewater pH - The optimal pH to maximize adsorption of arsenic by this term is acidic.
A. Adsorption C. Activated alumina
B. Activated carbon (AC) D. None of the above

277. In two groundwater and surface water projects the influent arsenic concentration was between this term, and the effluent concentration was less than 0.010 mg/L.
A. 10 ppb C. 0.010 mg/L and 0.050 mg/L
B. 0.010 mg/L D. None of the above

278. Of the ten drinking water projects (eight full and two pilot scale) having both influent and effluent arsenic concentration data, eight had influent concentrations greater than?
A. 10 ppb C. 0.050 mg/L
B. 0.010 mg/L D. None of the above

279. Effluent concentrations of less than 0.050 mg/L were achieved in seven of these projects. For two drinking water projects, the influent arsenic concentration was between this term, and the effluent concentration was less than 0.010 mg/L.
A. 0.010 mg/L and 0.050 mg/L C. 0.050 mg/L
B. 0.010 mg/L D. None of the above

280. Projects that did not reduce arsenic concentrations to below this term do not necessarily indicate that adsorption cannot achieve these levels.
A. 50 ppb to 10 ppb C. 0.050 or 0.010 mg/L
B. 0.010 mg/L D. None of the above

Ion Exchange Treatment for Arsenic
281. Which of the following has been used to treat groundwater and drinking water containing arsenic?
A. The exchange C. Ion exchange
B. Post-treatment D. None of the above

282. Based on the information collected to prepare this course, this technology typically can reduce arsenic concentrations to less than this term and in some cases has reduced arsenic concentrations to below _____.
A. 10 ppb C. 0.050 mg/L
B. 0.010 mg/L D. None of the above

283. Its effectiveness is sensitive to a variety of untreated water contaminants and characteristics. It is used less frequently than this term, and is most commonly used to treat groundwater and drinking water, or as a polishing step for other water treatment processes.
A. The exchange medium C. Precipitation/coprecipitation
B. Influent arsenic concentration D. None of the above

284. Ion exchange is a physical/chemical process in which ions held electrostatically on the surface of a solid are exchanged for ions of similar charge in?
A. A solution C. More frequent bed regeneration
B. A column D. None of the above

285. It removes ions from the aqueous phase by the exchange of cations or anions between the contaminants and?
A. The exchange medium C. Groundwater and drinking water
B. Influent arsenic concentration D. None of the above

Technology Description and Principles
286. The medium used for this term is typically a resin made from synthetic organic materials, inorganic materials, or natural polymeric materials that contain ionic functional groups.
A. Ion exchange C. More frequent bed regeneration
B. Replenish the exchanged ions D. None of the above

287. Dissolved arsenic is usually in an anionic form, and weak base resins tend to be effective over this term, and strong base resins are typically used for arsenic treatment.
A. A chloride ion C. A smaller pH range
B. Arsenic removal D. None of the above

288. Which of the following may also be categorized by the ion that is exchanged with the one in solution?
A. The regenerating solution C. Resins
B. A column D. None of the above

289. Resins that exchange a chloride ion are referred to as?
A. An anionic form C. The regeneration process
B. Chloride-form resins D. None of the above

290. Resins that preferentially exchange sulfate ions are referred to as?
A. Sulfate-selective C. More frequent bed regeneration
B. A column D. None of the above

291. Both sulfate-selective and nitrate-selective resins have been used for?
A. A column C. The regeneration process
B. Arsenic removal D. None of the above

292. The resin is usually packed into this term, and as contaminated water is passed through the column, contaminant ions are exchanged for other ions such as chloride or hydroxide in the resin.
A. A column C. The regeneration process
B. Arsenic removal D. None of the above

293. Ion exchange is often preceded by treatments such as this term to remove organics, suspended solids, and other contaminants that can foul the resins and reduce their effectiveness.
A. The regeneration process C. Filtration and oil-water separation
B. Arsenic removal D. None of the above

294. Which of the following resins must be periodically regenerated to remove the adsorbed contaminants and replenish the exchanged ions?
A. Ion exchange C. Bed regeneration
B. Column D. None of the above

295. The volume of spent regeneration solution ranges from 1.5 to 10 percent of the treated water volume depending on the feed water quality and type of unit?
A. Ion exchange C. The regeneration process
B. Arsenic removal D. None of the above

296. The number of _____ that can be treated before regeneration is needed can range from 300 to 60,000.
A. Ion exchange bed volumes C. Bed regenerations
B. Columns D. None of the above

Factors Affecting Ion Exchange Performance
297. Valence state - As(III) is generally not removed by?
A. The regeneration process C. Ion exchange
B. Arsenic removal D. None of the above

298. Which of the following can reduce the effectiveness of ion exchange if ions in the resin are replaced by ions other than arsenic, resulting in a need for more frequent bed regeneration?
A. Frequent bed regeneration
B. Exchange ion
C. The regenerating solution
D. None of the above

299. Fouling - The presence of organics, suspended solids, calcium, or iron, can cause this missing term of ion exchange resins.
A. The regeneration process
B. Arsenic removal
C. Fouling
D. None of the above

300. Presence of trivalent iron - The presence of Fe (III) could cause arsenic to form complexes with the iron that are not removed by?
A. Ion exchange
B. The regenerating solution
C. Frequent bed regeneration
D. None of the above

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