

Arsenic and Uranium Removal

Course Outline

Course Description

This 1 day (6 hour) course is designed to increase the participant's knowledge in methods of removing arsenic and uranium as well as their application, proper operation, and maintenance requirement.

Course Pre-requisites

There are no specific pre-requisites for this course. However, Grade 12 (or equivalent) math skills are an asset. Math upgrades are available –contact us.

Continuing Education Units (CEUs)

This course is recognized by EOCP for 0.6 CEUs (core for SWS, BWD and WT certifications and related for WD, WWT, WWC and SWWS certifications).

Course Duration

- 1 day
- 8:30 am to 4:00 pm
- 1 hour lunch break
- morning and afternoon break (15 minutes each)

Course Topics and Learning Outcomes

- Understand what arsenic and uranium are, and why they are found in drinking water;
- Define the Health Canada guidelines for arsenic and uranium in drinking water;
- Understand the health effects that exceedances in uranium and arsenic can have on human health;
- Identify methods to remove arsenic and uranium from raw water;
- Compare treatment technologies for arsenic and uranium;
- Explain which treatment methods are preferred, and why.

Delivery Method/Format

Instructional Method	Percentage of Class Time
Examples/Case Study	20%
Presentation/Lecture	50%
Slides	10%
Tutoring	20%

Material/Handouts (supplied)

- Student Binder: Yukon University. Arsenic and Uranium Removal; an elective –Technical Development– course. Whitehorse, Yukon.
- EOCP Course Completion and Evaluation Form.
 - every student needs to complete and return this form for any CEU allocation
- Calculators are provided but students are welcome to use their own.
 - please return

Course Requirements

Attendance and participation in class are required. CEUs will be allocated based on attendance and course completion; Yukon University records will show a pass or fail result. If the participant doesn't attend the class, Yukon University records will show a "no show" result and no CEUs will be allocated.

Evaluation

There will be a quantifiable evaluation at the end of this course with a passing mark of 70%. Please note that this evaluation is for self-assessment purpose only.

Appropriate Language

In all areas of the University environment, students are responsible for showing respect for others. Swearing, or language that is discriminatory or derogatory in relation to race, sex, ethnic background, religious beliefs, age, and physical condition is not appropriate.

Electronic Devices

In order to be successful in classes and minimize distractions for others, cell phones, iPods, and other electronic devices must be turned off while students are in class. In an emergency situation, the instructor may give a student permission to use a cell phone or pager.

Academic and Student Conduct

Information on academic standing and student rights and responsibilities can be found in the current Academic Regulations that are posted on the Student Services/Admissions & Registrations web page.

Plagiarism

Plagiarism is a serious academic offence. Plagiarism occurs when students present the words of someone else as their own. Plagiarism can be the deliberate use of a whole piece of another person's writing, but more frequently it occurs when students fail to acknowledge and document sources from which they have taken material. Whenever the words, research or ideas of others are directly quoted or paraphrased, they must be documented according to an accepted manuscript style (e.g., APA, CSE, MLA, etc.). Resubmitting a paper which has previously received credit is also considered plagiarism. Students who plagiarize material for assignments will receive a mark of zero (F) on the assignment and may fail the course. Plagiarism may also result in dismissal from a program of study or the University.

Academic Accommodation

Reasonable accommodations are available for students requiring an academic accommodation to fully participate in this class. These accommodations are available for students with a documented disability, chronic condition or any other grounds specified in section 8.0 of the Yukon University Academic Regulations (available on the Yukon University website). It is the student's responsibility to seek these accommodations. If a student requires an academic accommodation, they should contact the Learning Assistance Centre (LAC) at LearningAssistanceCentre@yukonu.ca.

Class Outline

Course introduction (10 min)

Uranium (5 min)

- Properties and sources of uranium in water

Arsenic (15 min)

- Sources of arsenic in water
- Properties of arsenite
- Properties of arsenate
- Electrical charges of arsenic complex compounds

Methods of Treatment (5 min)

- NSF Standard 61
- Adsorption, co-precipitation, and physical separation
- Engineered water blending

Engineered water blending (5 min)

Ion exchange media (40 min)

- Chemical process of adsorption by ion exchange
- Strong-base anion exchange resins
- Effects on competing cations
- Effects from suspended solids
- The reason for backwashing and regeneration of media
- Pre-oxidation using chlorine
- Lewatit® FO 36 media by Lanxess
- DOWEX HCR-S media by Dow
- ASM-10-HP media by ResinTech
- Purolite A300E media by Purolite
- AD92 IX media by Adedge

Activated alumina method (10 min)

- Adsorption method
- Requires oxidation of As (III) to form As (V)
- Method requires pH control
- The difference between regenerating media and disposing of spent media

Health Break (15 min)

Activated alumina method (45 min)

- Continued...

Other adsorption methods (60 min)

- Iron based activated alumina
- Backwash waste recycling
- Granular ferric hydroxide media by ADSORPAS®
- Bayoxide® E33 by Severn Trent Services
- NXT-2® by EP Minerals
- Media G2® media by ADI International
- ActiGuard AAFS50 by Alcan
- MetSorb™ HMRG by HydroGlobe Inc.

Lunch (60 min)

Oxidation/Filtration method (45 min)

- Precipitation and co-precipitation
- Converting arsenite to arsenate
- Oxidizing reagents
- Filtration after oxidation
- AD 26 media by Adedge
- Manganese greensand filtration (MGF) method explained
- MGF continuous regeneration
- MGF intermittent regeneration

Coagulation + Filtration method (15 min)

- Process using metal salts or lime softening
- Arsenic removal by precipitation, co-precipitation, and adsorption
- Types of sediment filters
- When do you change filters?

Membrane filtration method (15 min)

- The difference between micro, ultra, nano, and reverse osmosis membrane filtration
- Iron and manganese fouling of the membrane
- Reject wastewater

Health Break (15 min)

Package plants (10 min)

- Description of a package plant
- Advantages of package plants

Uranium and arsenic testing description (5 min)

- Description of the ANDalyze AND1000 fluorimeter
- Description of the Arsenic Econo-Quick™ II

Health Concerns (15 min)

- Long term arsenic low level exposure effects
- Short term uranium exposure effects

Point-of-use and point-of entry treatment units (15 min)

- Description of point-of-entry treatment units
- Description of point-of-use treatment units

Operations (15 min)

- Salt brine tank
- Calibrating on-line analyzers
- Testing and/or sampling raw and treated water
- Communications
- Regulatory and guideline compliance
- Developing and/or revising operating plans

Recordkeeping (30 min)

- Recordkeeping and reporting requirements
- Daily logbook for water treatment plant
- Personal operator logbook