Chemical Addition "Smart" Form (C-ADD-XLSM) Guidance and Instructions

Every Supplier of Water shall report to MassDEP at least once each month the use of chemicals added to the water supply. Such reports shall include, but not be limited to, the name of the chemical, the amount added, the resulting concentration of the chemical in the water, and the reason for adding the chemical to the water (310 CMR 22.15(4)).

The way in which chemicals are purchased, mixed/diluted and measured can vary from one water system to another. MassDEP has developed a flow chart to assist operators in populating the dosage calculation appropriately. Please refer to Appendix B.

General:

- Each chemical applied requires a separate chemical addition form submission (with the exception of fluoride). If there are multiple points of chemical application, such as pre and post-filter, a separate C-ADD form is required for each addition point unless a single day tank is utilized.
- PWS's that fluoridate shall continue reporting on the DEP/DPH forms as required.
- The frequency of measurements is daily unless otherwise approved.
- Forms must be completely filled out. Use 'not applicable' (N/A) in any area that is not applicable to your system.
- Continue to submit C-ADD forms even when a treatment plant is temporarily off-line, indicating 'off-line' in the O&M comment field. Do not populate fields in Section III. Daily reporting with data when a plant is 'off-line' or reports could contain erroneous data points or appear incomplete.
- Forms must be submitted to the appropriate MassDEP Regional Office no later than the 10th of the month following the reporting month.
- Download the most recent Chemical Addition Report form from the MassDEP website at https://www.mass.gov/how-to/chemical-addition-report, since the lookup fields (PWS Name, Town, Treatment Plant Name, Plant Availability, and Plant Status) will be updated regularly.
- The Calculated Chemical Used and Chemical Dosage values will automatically recalculate whenever the Purchased Strength, Purchased Density, Dilution Factor or Mix Ratio, or Treated Water volume values are changed.
- The print area is preset and excludes the area on the worksheet containing the calculators. You should not have to adjust the print area.

Section I: PWS INFORMATION

1. Select the **PWS ID** from the dropdown list. The **PWS Name** and **Town** will automatically populate.
2. Select the **Treatment Plant ID#** from the dropdown list. The list of treatment plant ID #s is filtered based on the **PWS ID** selection in the previous step. The **Treatment Plant ID #** should correspond with the prepopulated information from the PWS's Annual Statistical Report (ASR) "Treatment Plants" Section. The **Treatment Plant Name**, **Plant Availability**, and **Plant Status** will automatically populate.
    - If treatment is applied at an individual source, booster station or other location that is not reflected in the "Treatment Plants" section of the ASR please contact your MassDEP Regional Office for assignment of a Treatment Plant ID number.
    - If the **Plant Availability** and/or **Plant Status** is incorrect please contact your MassDEP Regional Office to update this information.
3. **Reporting Period:** Select the operating month and year represented in the report.

Section II: CHEMICAL & OPERATIONAL INFORMATION

It is important that all of the chemical information fields are completed as found on the safety data sheet (SDS) for each chemical. A SDS for each chemical should be requested at the time of delivery. Compare the new SDS to the previous one to ensure equivalent product. Make any necessary changes to the chemical addition report if there are changes in the SDS.

4. **Chemical Name:** (Refer to SDS Section 1- Identification)
    - Example: "sodium hypochlorite"
5. **Manufacturer:** (Refer to SDS Section 1 – Identification)
    - Example: "Borden & Remington Corporation, Carus Corporation"
6. **Product Name:** As known by manufacturer or propriety label
    - Example: "Borchlor 5, Carus 8700, CAIROX"
7. **Reason for Adding Chemical:** Specify the treatment objective for each chemical applied.
    - Example: "oxidation", "disinfection", "coagulation", "flocculation", "softening", "precipitation", "sequestering", "pH adjustment", "corrosion control".
    - Ensure all objectives are included. For example, chlorine can be an oxidant, disinfectant, or both.
8. **Purchased Strength (**Refer to SDS Section 1 – Identification)
    - You can report the Purchased Strength in either decimal or percent. Select the appropriate units. The default unit of measure is percent.
    - Enter the Purchased Strength value. You can switch between decimal and percent by selecting the appropriate radio button. The value you entered will update accordingly.
9. **Purchased Density (lbs/gal):** (Refer to SDS Section 9 - Physical Characteristics).
    - Provide the purchased **Density** (lbs/gal) (not be confused with specific gravity).
    - If only specific gravity or relative density is given (g/mL), use the **SPECIFIC GRAVITY TO DENSITY CALCULATOR** on the worksheet to calculate the Purchased Density.

      SPECIFIC GRAVITY TO DENSITY CALCULATOR INSTRUCTIONS

      1. Enter the **Specific Gravity** or relative density value.
      2. Density will be automatically calculated and displayed.
      3. Click the "Use This Value" button to populate the **Purchased Density** field in the form with the calculated value.

    - Alternatively, to perform the calculation manually, multiply the specific gravity or relative density (g/mL) by 8.34 to obtain density (lbs/gal).
        i. Example: density of 15.7 lb/gal should be reported as "15.7".
        ii. Example: 12.5% sodium hypochlorite does not have a reported density. The specific gravity is reported as 1.21. Density is calculated as follows: 1.21 x 8.34 = 10.1 lbs/gal. Report the density as "10.1".
    - Use a measured value if available; otherwise, if a range is given use the average between the high and low number.

10. **Dilution Factor or Mix Ratio:** Must be reported if a liquid chemical is diluted or a dry chemical is batch mixed with water by the PWS operator prior to dosing (not to be confused with purchased strength).
For Liquid Chemical:
    - To calculate the dilution factor use the **DILUTION FACTOR (FOR LIQUIDS) CALCULATOR** on the worksheet.

> **DILUTION FACTOR (FOR LIQUIDS) CALCULATOR INSTRUCTIONS**
>
> 1. Enter the amount of chemical in **# Parts Chemical.**
> 2. Enter the amount of water in **# Parts Water**.
> 3. Dilution factor will be automatically calculated and displayed.
> 4. Click the "Use this value" button to populate the **Dilution Factor** field on the form with the calculated value.

    - Alternatively, to calculate dilution factor manually, divide the amount of liquid chemical by the total volume of both water and chemical. Dilution factor should always be expressed as a decimal.
        - Example: 5 parts of chemical diluted with 5 parts of water. Dilution is calculated by ($5_{chemical}$/[$5_{chemical}$+5_{water}]) = 0.50 (a 50% dilution). Report "0.5".
        - Example: 1 parts of chemical diluted with 10 parts of water. Dilution is calculated by ($1_{chemical}$/[$1_{chemical}$+10_{water}]) = 0.09 (a 9% dilution). Report "0.09".

For Dry Chemical:
    - To calculate the dry chemical mix ratio use the **MIX RATIO (FOR DRY CHEMICALS) CALCULATOR** on the worksheet.

> **MIX RATIO (FOR DRY CHEMICALS) CALCULATOR INSTRUCTIONS**
>
> 1. Dry chemical mix ratio is calculated based on how the chemical usage is measured, via scale weight or in a day tank. Select the appropriate **Measurement Type** from the dropdown list.
> 2. Enter the **Weight of chemical (lbs).**
> 3. Enter the **Volume of water (gallons).**
> 4. Mix ratio will be automatically calculated and displayed.
> 5. Click the "Use this value" button to populate **Mix Ratio** field on the form with the calculated value.

    - Alternatively, to manually calculate the mix ratio:
        i. Dry chemical mix ratio is calculated based on how the chemical usage is measured, via *scale weight* or in a *day tank*.
        ii. ***If using a scale***, the mix ratio is determined by dividing the pounds of chemical being added by the amount of water in gallons to which it is being added. This mix ratio (lbs/gal) is then divided by 8.34 lbs/gal to obtain a ratio represented in lbs/lb.
            - Example: Mix 25 lbs of sodium hexametaphosphate in 50 gallons of water. Mix ratio is calculated by [(25 $lbs_{chemical}$/50 gal_{water})]/(8.34) = 0.06 lbs/lb
        iii. ***If using a day tank***, the mix ratio is determined by dividing the pounds of chemical being added by the amount of water in gallons to which it is being added.
            - Example: Mix 25 lbs of sodium hexametaphosphate in 50 gallons of water. Mix ratio is calculated by (25 $lbs_{chemical}$/50 gal_{water})= 0.5 lbs/gal

11. **NSF Approved (Y/N):** Refer to the NSF Drinking Water Chemicals - Health Effects pdf document to identify that the chemical being applied is NSF/ANSI 60 compliant: http://www.nsf.org/newsroom_pdf/NSF-ANSI_60_watemarked.pdf

12. **Target Residual Range/Minimum:** These parameters may be defined in permit conditions, O&M manuals, bench top studies, pilot studies, best operational practices, etc. These residual ranges/minimum values are measured and recorded in section III to ensure treatment effectiveness. In some instances residuals are not monitored and therefore the target range or minimum value refers to the chemical target dose (see footnote 13).
    - A particular chemical may have a target residual range, a target residual minimum, or both.
    - Target residual minimum is the minimum value required to be maintained in the treated water.
    - Regulatory limits, if established, should always be the primary source for target residual range/minimum, unless there is a more stringent permit condition.
    - Example: Caustic Target Residual Range (7.3 to 7.8 pH); Caustic Target Residual Minimum (7.5 pH); Chlorine Target Residual Range (0.8 to 1.0 mg/L); Orthophosphate Target residual minimum (1.0 mg/L).
    - Permit conditions, if established, should be used as a source for target residual range/minimum.
    - It is important that the residual readings collected in Section III are constantly compared to the target values to ensure chemical application is optimal.

13. **Target Dose:** A target dose shall be identified, if established, based on regulatory requirements or permit conditions. This must be specified in the O&M notes section (22). If no target dose is established then the field should read "NA".
    - Given that dosage for chemicals can vary for numerous reasons, such as changes in source water, seasonal changes and additional chemical treatment in use, unexplained or significant dosage variations should be explained in the O&M notes section (22).
    - Example: Permit condition requires that coagulant dose should be between 20 and 28 mg/L. Report "20-28".

14. **Alarm Settings (low/high):** Enter alarm setting used to measure the chemical's associated monitoring parameter (pH, chlorine residual, etc.). Alarm settings should be based on availability of alarms, permit conditions, compliance levels, max dosage levels of chemical, optimal operational chemical levels, and type of chemical. If the system does not have alarms in place, fill out box with N/A. Alarms shall be tested quarterly at a minimum. Refer to https://www.mass.gov/media/969976/ (MS Word) or https://www.mass.gov/media/1337176/ (PDF) for the Water Treatment Chemical Feed System Control and Alarm Testing Log.
    - Low/High Alarm settings should reflect operational/notification set points to ensure safe and reliable dosage of chemical and may have a narrow range, with goals of alerting the operator or shutting down the plant prior to failing compliance parameters, and prevention of overfeeding and underfeeding of chemical prior to the first customer.
    - In addition to traditional low/high alarm settings, a High High/Low Low alarm setting can be used with a broader range to trigger a plant shut down.
    - Alarm settings must not exceed the full range of the instrument. For example, a low alarm setting at "0" would never be triggered, as the analyzer can't read below "0", or a high alarm at "4 or 5", if the analyzer can't read above 4.
    - MassDEP has established immediate action levels for some chemicals. These limits are intended for use by plant operators to identify when a situation involving chemical over-feeds or use of the wrong chemical has occurred of sufficient gravity to require the implementation of emergency response procedures. These levels can be found in "**MassDEP Immediate Action**

Levels for Water Treatment Plant Chemicals" at: https://www.mass.gov/guides/drinking-water-standards-and-guidelines or at https://www.mass.gov/media/1350316/

15. **Date of last anti-siphon valve inspection/replacement:** Fill in the appropriate date. The Guidelines call for chemical feed systems to be configured to prevent siphoning of chemicals into the water being treated. As part of this requirement, any device intended to provide the required protection must function properly. To ensure that the devices will function as intended, any devices used to provide the required protection need to be inspected, maintained, and replaced as necessary. MassDEP considers that this needs to be done annually or more frequently if recommended by the device manufacturer; including the date on the Chemical Addition Form documents compliance with this requirement of the Guideline.

Section III: DAILY REPORTING

It is important to understand that the amount of water pumped should be measured at the same time daily as the readings for chemical usage are collected. Although some variation in dosage is expected, the calculated day-to-day dosage should be fairly consistent based upon the volume of Treated Water and Chemical Used during the same operating period. For systems that take daily measurements, the usages should ideally represent a 24-hour period. Transducers in day tanks can be used to more accurately reflect and correlate flows with chemical usage. Ensure that chemical tanks are accurately and permanently marked at proper volumetric increments and scales are routinely calibrated. Systems that have only weekly site visits should use the cumulative water production from the time of the last site visit for the calculation of dosage.

- Example: If water meter readings are taken at 12 AM each day via SCADA, the measured chemical used in section III, item 17, should represent that same 24-hour period. (Water production from 12AM – 12 AM does not appropriately correlate with an 8AM – 8AM chemical usage reading.)
- Regardless of the volume of Treated Water, the dosage should be fairly stable.
- Example: On day one, 348,000 gal of treated water is calculated to have a dosage of 3.5 mg/L of permanganate. On day two, 79,000 gal of treated water is calculated to have a dosage of 0.16 mg/L permanganate. Unless the dosage was intentionally changed by the operator, this should be considered an indication of either improper chemical measurement, or poor chemical feed control and the water system should take steps to rectify the situation.

16. **Treated Water:** Amount of water pumped and treated. The volume may be expressed as gallons or MG.
    - Select the unit of measure, either Gallons or MG (millions of gallons). You can switch between Gallons and MG by selecting the appropriate radio button. The values you entered will update accordingly.
17. **Measured Chemical Used:**
    - **Volume (gal/day):** Must be completed for liquid chemicals where the volume used in gallons is measured by the level in the day tank. This is the amount of chemical solution that has been used in the day tank for the operational period being measured, i.e., 24 hour period or weekly (for VSS systems).
        i. "Eyeballing" or estimating day tank levels is discouraged. Day tanks must be provided with a means to measure the amount of chemical used, such as ultrasonic level sensing, gauge rods with floats, or visual calibration (such as increments marked on the exterior of the tank) where the ratio of the tank height and diameter are meaningful.

ii. Note: systems using day tanks without gallon increments scribed/permanently marked on the tank will need to calculate gallons to inches ratio. Use the **GALLONS/INCH CALCULATOR** or refer to **Appendix A** for guidance on volume calculations.

GALLONS/INCH CALCULATOR INSTRUCTIONS

1. Enter the **Day Tank Diameter (feet).**
2. Enter the **Day Tank Height (feet)**.
3. The gallons/inch value is automatically calculated and displayed.
4. Enter the **Starting inch value**.
5. Enter the **Ending inch value**.
6. The volume used, in gallons, is automatically calculated and displayed.
7. Click the "Use this Value for…" button to populate the appropriate field on the form with the calculated volume.
8. A pop-up will display with instructions. Click a cell in the **Volume (gal/day)** column of **Measured Chemical Used** to copy the calculated volume to the cell.
9. Confirm to copy the value to the cell by clicking the "Yes" button on the pop-up. The calculated volume will be copied to the cell.

- **Weight (lbs/day):** Must be completed for dry chemical (i.e., batch mixed) and gaseous cylinders or liquid chemicals where the chemical used is measured in pounds via scale weight.

18. **Calculated Chemical Used:** This value is derived from the numerator (top) portion of the dosage calculation and is represented as pounds. This value takes into account the purchased strength (footnote 8) and dilution factor or mix ratio (footnote 10).
    - The value is automatically calculated. Refer to Appendix A and B for an explanation on how this value is calculated.
19. **Calculated Chemical Dosage (mg/L):** The dosage is automatically calculated. See **Appendix A and B** for an explanation on how the dosage is calculated.
20. **Parameters Measured, Units and Method:** Report the parameter being measured, location in the treatment train where the parameter is being monitored, and the units of measure in the column headings.
    - Data should be recorded and reviewed to ensure optimal treatment dosage of the chemical applied. Fill in boxes as appropriate.
    - Example: "chlorine residual post filter (mg/L)" or "chlorine residual 100 ft. tap (mg/L) weekly grab" or "pH 100 ft. tap".
    - Grab or Continuous may be indicated using the checkboxes in item (21).
    - Multiple columns are provided for measuring parameters at multiple locations, and the headings should be customized by the PWS for each location.
    - Example: A system applies KOH for pH adjustment. There is a continuous analyzer in place for pH. The analyzer records the average pH for each 24-hour period and weekly pH grab samples are collected to verify analyzer accuracy. For reporting, use two columns. First column report "pH daily average". Second column report "pH weekly grab sample".
    - In the space provided at the bottom left of the form ***(a., b., c.)*** for each measured parameter, describe what the result represents (daily average, daily min/max, instantaneous analyzer reading, grab, etc.), the analyzer or sample location (entry-point, before/after filters, tanks, clearwell, etc.) and instrumentation used (SCADA, chart recorder, test kit, bench instrument, etc.)

- Examples: "*a.* daily average at entry point via SCADA", "*b.* instantaneous reading after filter vessel from analyzer", "*c.* daily min at entry-point from chart recorder", "*a.* grab sample before storage tank measured with test kit", etc.
- Parameters may have different target residuals at each location. If so, use sections *a., b., c.,* to explain the individual targets.
- For corrosion control chemicals measured at the entry point, the daily reported parameter value must be the <u>average</u> of all results collected during the day (grab or continuous).

Notes on selecting parameters for reporting:

- Residual data may represent various situations. Choose the one that best reflects operational needs for decision making and treatment adjustments. Possibilities to consider include daily average (via SCADA), variable – routine/random instantaneous reading of SCADA display, highest or lowest reading (via SCADA or chart recorder). If the reported residual number is an average, a small change in day-to-day residuals can indicate larger swings during the day. If an instantaneous or variable reading is used, it is important to ensure that the reading represents the treatment operating under routine conditions (i.e., avoiding spikes at start-up/backwashing etc.).
- Systems optimizing **<u>corrosion control treatment</u>** must maintain water quality control parameters (WQPs) at or above minimum values or within ranges designated by MassDEP. Ensure that parameter measurements (i.e., pH, corrosion inhibitor, alkalinity, calcium) are being properly recorded, in accordance with 310 CMR 22.06B(3)(g) requirements. Please note, a water system is out of compliance if it has excursions for any MassDEP-specified parameter for more than nine days (at any combination of entry-point or distribution system locations) during the six-month monitoring periods of (JAN-JUN or JUL-DEC).
    - On days when more than one measurement for the water quality parameter is collected at the sampling location, the <u>daily value shall be the average of all results collected during the day</u> regardless of whether they are collected through continuous monitoring, grab sampling, or a combination of both. Note, if continuous monitoring is present report the average of all measurements recorded under pumping/flow conditions during chemical application.
    - On the days when only one measurement for the water quality parameter is collected at the sampling location, the <u>daily reported value shall be the result</u> of that measurement.
    - On days when no measurement is collected for the water quality parameter at the sampling location, the daily value shall be the daily value calculated on the most recent day on which the water quality was measured at the sample site.
    - To minimize the number of days counted as excursions, a system should take a confirmation sample as soon as possible when a daily value is below the minimum value or outside the range designated by MassDEP and take appropriate actions.

21. **(G)rab or Continuous (A)nalyzer:** Indicate whether the residual data being reported are obtained from an on-line (A)nalyzer reading from a SCADA system or from a (G)rab sample collected and measured with a calibrated measurement device (i.e., HACH kit or bench top instrument). A reading from an on-line analyzer display is not considered a grab sample.
    - When analyzers are being used, the readings from the analyzers should be periodically (i.e., once per week) compared to measurements made with benchtop instruments of a grab sample to validate the readings of the analyzers, as called for in the Guidelines, and those comparisons should be documented on the form.

- For systems using continuous analyzers for compliance with GWR 4-Log disinfection or the SWTR, the Regulations under 310 CMR 22.20A(5), call for the continuous monitoring instruments to be calibrated at least once every 5 days. Systems may meet this requirement by making comparisons of the readings from the continuous instrument to measurements made with benchtop instruments. To document compliance with the requirement of the Regulation, MassDEP is requesting that systems record the calibrations or comparisons on the day they are made, utilizing one of the available columns. The column shall be labeled "grab" and the description of what the result(s) represent filled out appropriately in the lower left-hand corner (see Item 20).

22. **O & M Notes/Comments:** Report Operations and Maintenance Notes relevant to the reported parameters or targets. Note any equipment breakdown, changes in purchased product, or batch mixing day, treatment or sources that are off-line, etc. Also use this section to comment on measured parameters or dosages that are out of target range.
    - This section must be utilized to describe or explain any variations from the target dosage, lack of a dosage calculation, variations in measured parameters outside of target values, etc.
    - If this space is insufficient, attach additional pages as necessary to fully explain the issues and how they were addressed.
23. **Monthly Target Summary:** Indicate the total number of days during the month that the target residual indicated in Section (12) was not achieved while the plant was in operation.
24. **PWS Authorized Person:** Prior to signature, data should be reviewed to ensure report is complete and optimal treatment dosage of the chemical is being applied. A PWS authorized person (preferably a licensed treatment operator and/or supervisor), must sign, print name, indicate title and date each submission. The primary treatment operator is ultimately responsible for form content. Lack of signature is considered an incomplete submission.

Dry Chemical or liquid chemical measured in pounds via scale weight:

$$\text{Dosage (mg/L)} = \frac{\text{(Purchased strength)(Dilution factor or mix ratio)(Pounds of chemical)}}{\text{(Amount of treated water in MGD)(8.34)}}$$

Liquid chemical measured via day tank level (gallons): *In order to convert gallons to pounds you must multiply gallons, purchased strength and density. If a dilution factor is being used it must also be multiplied.*

No dilution factor or mix ratio

$$\text{Dosage (mg/L)} = \frac{\text{(Purchased strength)(Volume of chemical)(Density)}}{\text{(Amount of treated water in MGD)(8.34)}}$$

With dilution factor or mix ratio

$$\text{Dosage (mg/L)} = \frac{\text{(Purchased strength)(Dilution factor or mix ratio)(Volume of chemical)(Density)}}{\text{(Amount of treated water in MGD)(8.34)}}$$

Converting inches to gallons (day tank measurement): d (diameter) and h (height) are represented in feet.

Step 1: To find gallons in day tank you must calculate volume of a cylinder

$$V=(0.785)(d^2)(h) \times 7.48$$

Step 2: Divide the # of gallons from the equation above by the height of the day tank in inches to obtain gal/inch

Example: no dilution measuring from a day tank, liquid chemical

- PWS #1234567 using Chemical XYZ (liquid)
- Total Gallons of Water pumped = 255,000
- Volume of Chemical used = 5 gallons
- Chemical purchased strength = 33%
- Chemical density = 11.3 pounds/gallon
- **Dosage mg/L = $\frac{(0.33)(5)(11.3)}{(0.255)(8.34)}$ = 8.77 mg/L**

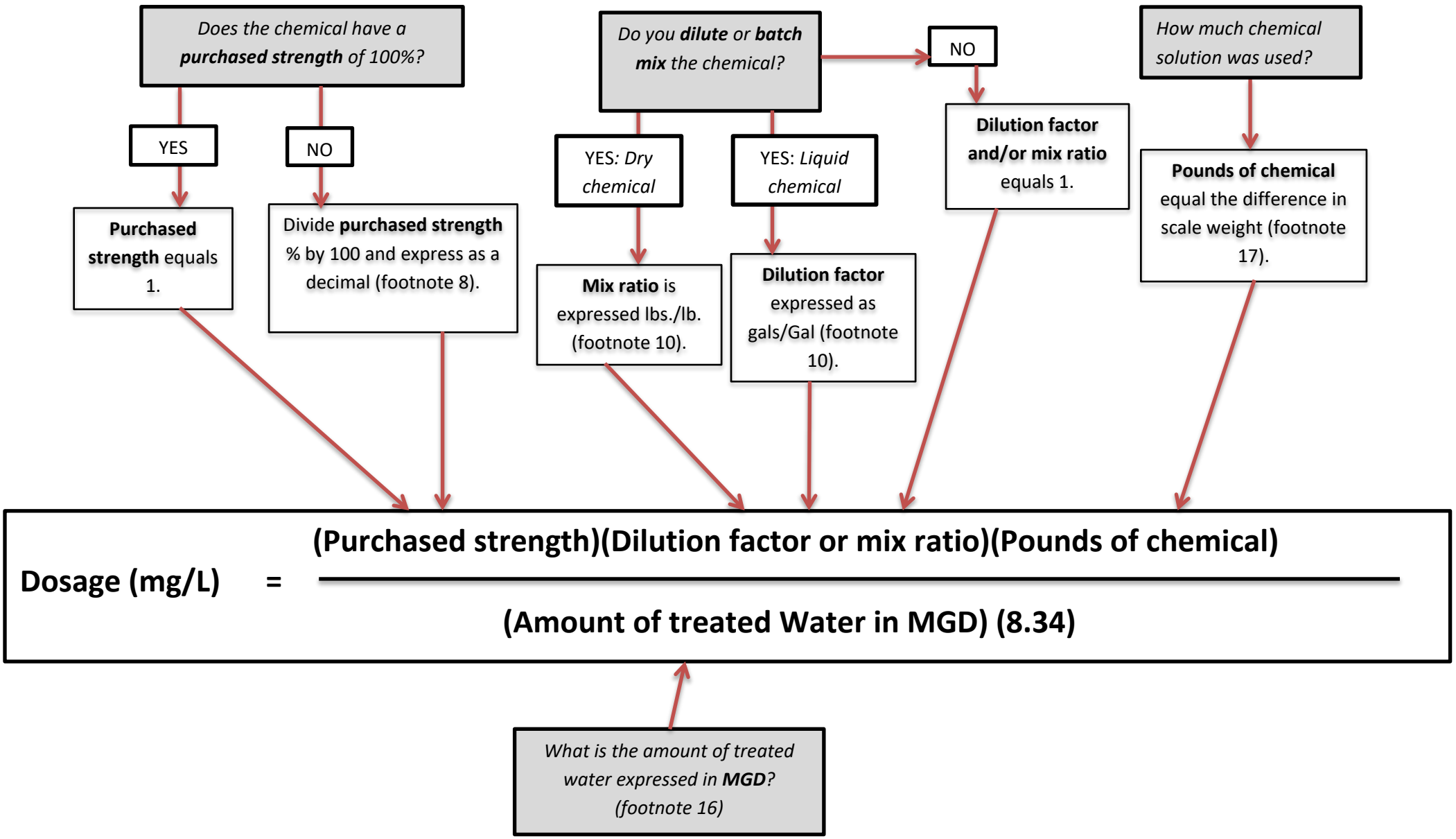
Example: with dilution measuring from a day tank, liquid chemical

- PWS #1234567 using Chemical XYZ (liquid)
- Total Gallons of Water pumped= 255,000
- Volume of Chemical used= 5 gallons
- Chemical purchased strength = 33%
- Chemical density = 11.3 pounds/gallon
- Chemical is diluted: 1 Gallon of chemical to 5 gallons of water = 1/6= 0.17 dilution factor
- **Dosage mg/L = $\frac{(0.33)(0.17)(5)(11.3)}{(0.255)(8.34)}$ = 1.49 mg/L**

Example: with batch mixing measuring from a scale, dry chemical

- PWS #1234567 using Chemical XYZ (dry)
- Total Gallons of Water pumped= 255,000
- Mix 25lbs chemical to 50 gallons of water= 25 lbs/50 Gal=0.5 lbs/Gal
- Mix ratio= (0.5 lbs/Gal)/(8.34 lbs/Gal)=0.06 lbs chemical/Lb solution
- Pounds of chemical solution used=109.0 lbs
- Purchased strength= 100%
- **Dosage mg/L = $\frac{(1)(0.06)(109)}{(0.255)(8.34)}$ = 3.1 mg/L**

Flow Chart Figure 1.1: Chemical Used Measured via Scale Weight



Flow Chart Figure 1.2: Chemical Used Measured from A Day Tank

