The Flow of Water Through a Chemical Manufacturing Facility

Chemical manufacturing is a water-intensive process, and water is a shared community resource. That's why chemical manufacturing facilities are advancing water stewardship, with an emphasis on responsible water usage and conservation efforts.

This infographic illustrates the process a chemical facility may undertake to access water from local sources, how and where water is used in the chemical manufacturing process, and steps taken to treat water before it is discharged back into watersheds.

1

- **Water may be withdrawn** from a river, lake, reservoir, groundwater, sea or public utility.
- Permits can limit withdrawal from water sources under certain circumstances (e.g., drought, regulatory limits, etc.), which can improve conservation and reuse efforts.
- Using only the water quantity necessary avoids excessive energy and chemical use.
- Treatment of raw water is generally needed to produce high-purity water used in the production process or to produce steam.
- Large tanks or lagoons may be used to store water prior to use at a facility.

2

Cooling systems represent a significant portion of water used in a chemical facility.[3]

- Cooling water is treated and may be returned to the watershed.
- **A recirculating cooling system** uses the same water repeatedly to cool reactions and products. Heat absorbed from the process must be dissipated to allow reuse of the water. **Cooling towers, spray ponds and evaporative condensers** are used for this purpose.
- **Once-through cooling** passes water through a condenser in one or two passes to remove the waste heat.

3

Steam generation is essential for process heating and can be used to generate electricity.

- Steam condensate is reused to improve energy and water efficiency.
- Minerals and other materials are removed through reverse-osmosis or ion exchange, as ultra-pure water is needed for this process.

4

Water may be used as a **reaction medium or solvent** in chemical processes, **product purification** steps and to **renew valuable catalysts**. These uses require high purity raw water treatment to meet specific requirements.[4] Water may also be used as a chemical reactant or product ingredient.

5

Ancillary Use

- Water is necessary for **cleaning, WASH (water, sanitation, hygiene) services, transportation** and other facility operations.
- Water is also used in heating and ventilation systems (HVACs) for both employees and processes.

6

On-site Storage

- Chemical plants may store large volumes of water for **fire protection** in tanks or lagoons.
- Water also may be stored in tanks and collected for **onsite or offsite wastewater treatment**.

7

Water used in a chemical process **is treated prior to discharge** to remove organics and other compounds in accordance with established permit limits.

- **Wastewater treatment facilities** may be located on-site, or at an off-site Publicly Owned Treatment Works (POTW).
- Prior to discharge, treated water must comply with discharge permit levels.[5]
- Wastewater treatment requirements are location-specific, aiming to minimize environmental impacts to local watersheds.[6]

8

Key Elements of Responsible Water Discharge Management Include:

- Monitoring water quantity and quality.
- Treating wastewater before discharge.
- Considering water stress, reuse opportunities and other factors.

Chemical manufacturers may also employ nature-based solutions, such as:

- Creating wetlands to collect and distribute rainwater and provide natural treatment and solutions to sustain ecosystems.
- Promoting water resilience and environmental balance.

Learn more about ACC's water stewardship activities and priorities in ACC's Sustainability Report[7], as well as initiatives individual ACC members are undertaking to advance water quality[8].

Resources:

1. Responsible Care® Overview - American Chemistry Council
2. Water - American Chemistry Council
3. Water Efficiency Management Guide Mechanical Systems (epa.gov)
4. The Principles of and Reasons for Using Water as a Solvent for Green Chemistry - Breslow - Major Reference Works - Wiley Online Library
5. NPDES Permits Around the Nation | US EPA
6. Lean & Water Toolkit: Chapter 2 | US EPA
7. Sustainability Starts with Chemistry - American Chemistry Council
8. Water - American Chemistry Council

202409-096