The Fundamentals of

RAW WATER TREATMENT

A PUBLICATION OF SAMCO TECHNOLOGIES

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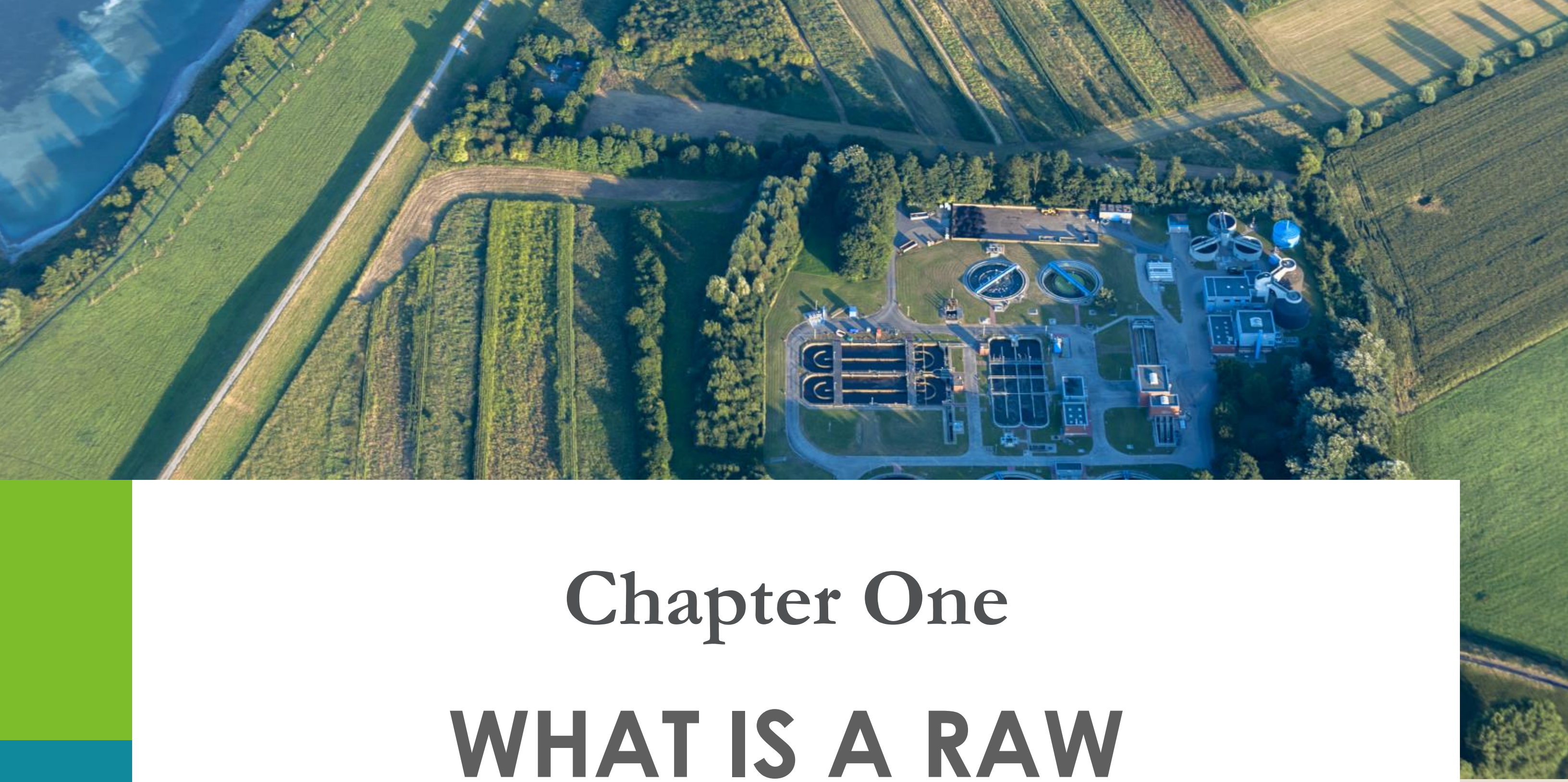


Chapter One

WHAT IS A RAW WATER TREATMENT SYSTEM AND HOW DOES IT WORK?

RAW WATER TREATMENT SYSTEMS

What they are and how they work

For an industrial company using a raw water source for its facility, some type of raw water treatment system is usually necessary to ensure an efficient process and quality product. The most appropriate raw water treatment system will help the facility avoid **costly plant downtime**, **expensive maintenance fees**, and **not being able to sell its products in the market**, among other problematic issues.

But **what is a raw water treatment system and how does it work**?

The complex answer to this question (which largely depends on the quality of the raw water source in relation to the quality of water needed for the plant) is simplified and broken down below:

What is a raw water treatment system?

A raw water treatment system is **a system made up of several individual technologies that address the facility's specific raw water treatment needs**.

Treating raw water is rarely a static process, and a raw water treatment system that is engineered to accommodate fluctuations in treatment needs will go a long way in avoiding costly replacements/upgrades down the line.

An efficient and well-designed raw water treatment system should be able to handle:

- seasonal variations in turbidity and flow
- variations in water chemistry needs and required chemical volumes adjustments
- changes in water quality requirements (such as the quality of feed water required for a new boiler)

What's included in a basic raw water treatment system?

As mentioned above, the exact components of a raw water treatment system will depend on the **quality of water being drawn from** in relation to the **quality of water needed**, but in general, a basic raw water treatment system typically includes some type of:

- **chemical feed** to help facilitate the flocculation or coagulation of any suspended solids
- **clarifier** to settle out the larger solids
- **filtration** to remove the smaller particles
- **control panel** (depending on the level of automated operation needed)

Depending on the needs of the plant and process, these standard components are usually adequate, however, if the plant requires a system that provides a bit more customization, there might be some features or technologies that will need to be added on.

What does a raw water treatment system typically remove?

A raw water treatment system might be made up of the technologies necessary to remove any number of the following:

- **Suspended and colloidal solids:** they can cause unpleasant odors in food and beverage products, foul process equipment, and create energy losses for the plant.
- **Silica and colloidal silica:** they often foul and scale boiler equipment, reduce the efficiency of plant equipment, and cause product contamination.
- **Iron:** coats fixtures, fouls industrial processes, causes foul tastes and odors in products.
- **Bacteria:** can cause sickness and severe digestive issues/health problems as well as coat cooling tower components.
- **Hardness:** coats equipment fixtures, plugs pipes, scales equipment, and causes a buildup of sludge.

How does a raw water treatment system work?

A typical raw water treatment facility process will usually include the following steps:

Raw water intake

Raw water (untreated water found naturally in the environment) can come from many sources, including rivers, lakes, oceans, or groundwater. Usually, when an industrial plant draws in the water from their surface water source, they pull it in (with pipes or by gravity) through a mesh screen or grate to **eliminate the larger objects**, such as twigs, leaves, and fish. The water is then pumped to the main facility where treatment begins.

Coagulation

After all the large objects are removed from the raw water source, various chemicals are added to a reaction tank to remove the bulk suspended solids and other various contaminants. This process starts off with an assortment of mixing reactors, typically one or two reactors that add specific chemicals to **take out all the finer particles in the water** by combining them into heavier particles that settle out. The most widely used coagulates are aluminum-based such as alum and polyaluminum chloride.

Sometimes a slight pH adjustment will help coagulate the particles, as well.

Flocculation

When coagulation is complete, the water enters a flocculation chamber where the coagulated particles are slowly stirred together with long-chain polymers (charged molecules that grab all the colloidal and coagulated particles and pull them together), **creating visible, settleable particles** that resemble snowflakes.

Sedimentation

The gravity settler (or sedimentation part of the raw water treatment process) is typically a large circular device where flocculated material and water flow into the chamber and circulate from the center out. In a very slow settling process, the water rises to the top and overflows at the perimeter of the clarifier, **allowing the solids to settle down to the bottom of the clarifier into a sludge blanket**.

The solids are then raked to the center of the clarifier into a cylindrical tube where a slow mixing takes place and the sludge is pumped out of the bottom into a sludge-handling or dewatering operation.

The dewatering process takes all the water out of the sludge with filter or belt presses, yielding a solid cake. The sludge water is put onto the press and runs between two belts that squeeze the water out, and the sludge is then put into a big hopper that goes to either a landfill or a place that reuses the sludge. The water from this process is typically reused and added to the front end of the clarifier.

Filtration

The next step is generally running the water overflow into gravity sand filters. These filters are big areas where they put two to four feet of sand, which is a finely crushed silica sand with jagged edges. The sand is typically installed in the filter at a depth of two to four feet, where it packs tightly. The feed water is then passed through, **trapping the particles**.

On smaller industrial systems, you might go with a packed-bed pressure multimedia filter versus gravity sand filtration. Sometimes, depending on the water source and whether or not it has a lot of iron, you can also use a green sand filter instead of the sand filter, but for most part, the polishing step for conventional raw water treatment is sand filtration.

Ultrafiltration (UF) can also be used after the clarifiers instead of the gravity sand filter, or it can replace entire clarification process altogether. Membranes have become the newest technology for treatment, pumping water directly from the raw water source through the UF (post-chlorination) and **eliminating the entire clarifier/filtration train**.

Disinfection

After the water flows through the gravity sand filter, the next step is typically disinfection or chlorination **to kill the bacteria in the water**.

Sometimes this step is done upstream before filtration so the filters are disinfected and kept clean. If the system utilizes this step prior to filtration, more disinfectant will be needed . . . this way the filters are disinfected and kept free from bacteria (as well as the filtered water). When chlorine is added upfront, bacteria is being killed and will cause less fouling. If bacteria sits in the bed, you might grow slime and have to backwash the filters more often. So it all depends upon how the system operates . . . whether the system is set up to chlorinate upstream (prior to filtration) or downstream (after filtration).

Distribution

If the raw water treatment is being used in an industrial process, it's typically pumped into a holding tank where it can be used based on the demands of the facility. If for municipal use, the treated water is usually pumped into a distribution system of water towers and various collection and distribution devices in a loop throughout the city.

Other possible steps to the raw water treatment process

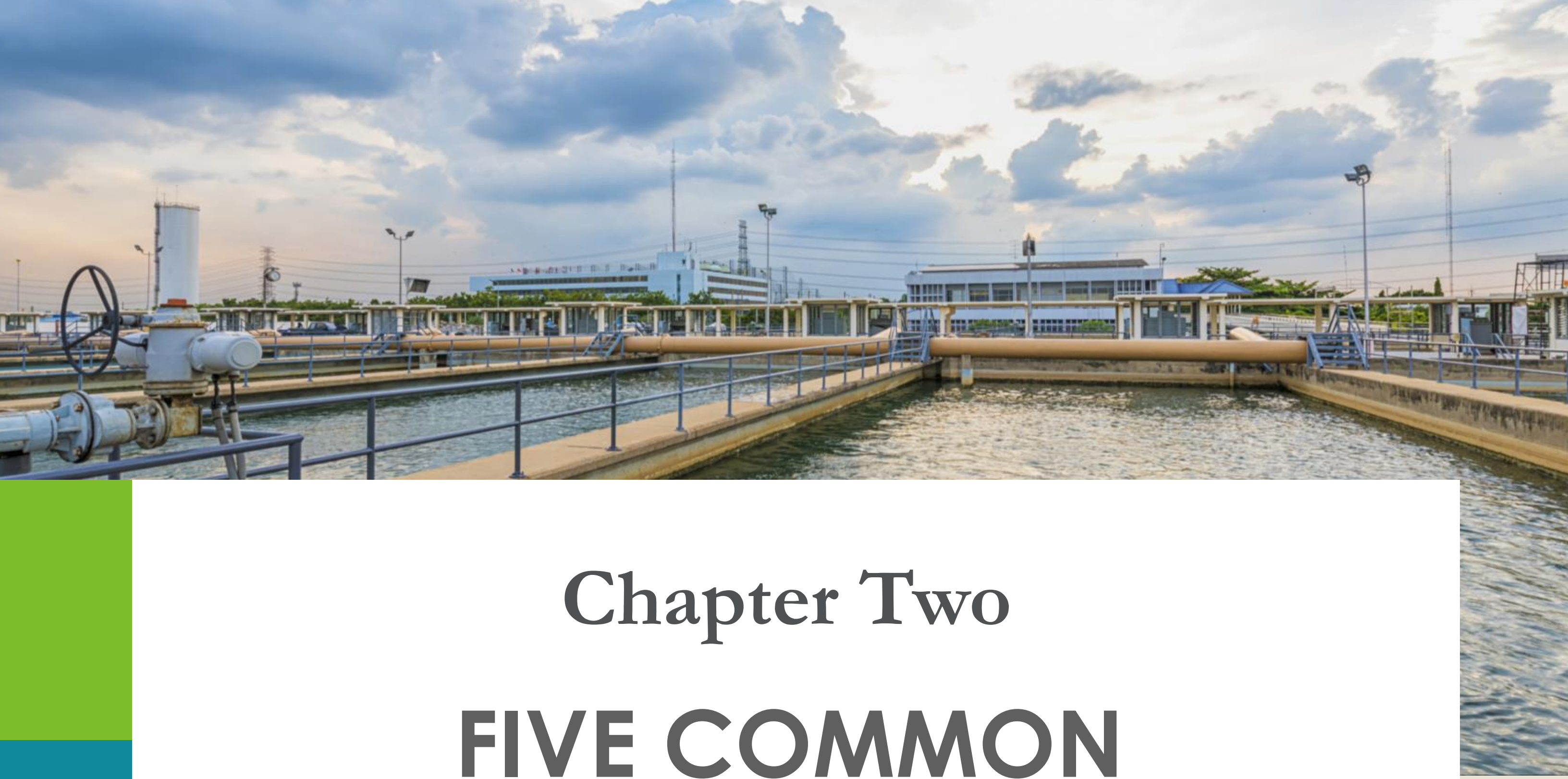
Although these methods are not always needed and depend upon the plant's process and quality requirements, some raw water treatment systems might include:

Lime softening

In waters where there is high hardness or sulfates, or other constituents you need to precipitate or take out, a lime and/or a lime soda process is used. It **raises the pH, causing hardness in the water to precipitate out**. Cold, warm, or hot lime processes can be used, and each will yield a different efficiency. In general, hotter water removes more hardness.

Ion exchange softening

In some industrial and municipal applications, if there's high hardness, there may be post treatment for the removal of the hardness. Instead of lime, a softening resin can be used; a strong acid cation exchange process, whereby resin is charged with a sodium ion, and as the hardness comes through, it has a higher affinity for calcium, magnesium, and iron so **it will grab that molecule and release the sodium molecule into the water**.



Chapter Two

FIVE COMMON PROBLEMS WITH RAW WATER TREATMENT AND HOW TO AVOID THEM

COMMON RAW WATER TREATMENT PROBLEMS

What are they? How do you avoid them?

For industrial companies treating a raw water source for its processes, there are several issues that can surface during treatment that we see on a regular basis. We've broken out the **five most common problems with raw water treatment and how to avoid them** below.

Whether you're designing a new plant or updating existing equipment, avoiding these five common raw water treatment problems might help you operate your process more efficiently down the line, so they're important to keep in mind and plan for ahead of time, if possible:

1. Variation in turbidity

When plants begin to experience a variation in turbidity—the cloudiness of water due to the presence of a large number of particles—it can have negative effects on the quality of the process and effluent from the plant. It's helpful to have a consistent year's worth of data to evaluate the turbidity levels coming into the plant from season to season prior to designing the system.

When the plant is designed around the seasonal turbidity flow without taking into consideration any of the changes it might see—if the turbidity increase without the plant being ready for this change—there are several problems that might occur.

When the turbidity is too high for the plant to remove it efficiently, it often carries over to production and can be present in your discharge, **contaminating your process and causing fines when local discharge regulations are not met**.

Another issue we see when turbidity levels vary, is the amount of sludge that's generated from treating the turbidity. Oftentimes secondary sludge systems can't handle the load, and therefore the **sludge backs up in the clarifier and shuts down the pretreatment system**.

The best way to combat this problem is to **design a slightly oversized treatment system** for turbidity, anticipating that variations will occur. It's also beneficial to **design a re-cycle system** so if the water doesn't meet the quality requirements as it moves through the process, it can be re-cycled through and retreated more thoroughly.

Another way to prepare for varying turbidity is to **include variable controls on your chemical feed** systems so you can adjust chemical feed rates. You can also **oversize the sludge handling system** so when you pump out the sludge in the clarifiers filters, you have a sludge handling system that, if the turbidity does fluctuate, has the ability to manage it.

2. Variation in flow

Many times, industrial companies make educated guesses as to what they think their flow rates are going to be. If an industrial facility is not equipped to handle these variations, they'll likely experience **upsets to the system** that will carry turbidity over and **plug any downstream filters**.

Understanding what peak demand is and using holding tanks to try to buffer out the peak demands is one way to prepare for flow variations. Typically, you want to design the system with an excess flow buffering/holding capacity so you can run your plant as consistently as possible and then use the holding tanks downstream to handle surges in production needs.

Another thing you can do is **put variable controls on your chemical feed systems,** so as your flow changes, your chemical feeders can ramp up and ramp down to handle it.

With a combination of variable flows on feed treatment equipment and storage on peak demands, you can get your system to balance out more easily and increase functionality. If you don't have the ability to automate chemicals, you will need to test more often. You can try to run your plant at a consistent flow rate to avoid these upsets and turbidity issues.

Raw water treatment plants do not handle variations in flow well, so it's helpful to design the system with this in mind from the start.

3. Changing feed chemistry

Many **surface and well waters have seasonal variations in water chemistry**. Industrial plants need to be very careful in the design of any raw water treatment systems to be large enough to handle these changes.

Let's say, for example, you have a problem with raw water iron or silica and it changes seasonally. If you haven't designed your clarifiers large enough to get the proper retention times and you haven't designed your feed systems large enough to handle the increased load, you'll get carryover with either **silica and/or iron** into the downstream equipment where they **cause all sorts of problems such as scaling and fouling**.

Secondarily, if you don't anticipate the higher seasonal loads of iron and silica and try to precipitate it out, you may then have particulate carryover to your sludge handling systems, causing them to fail.

All in all, **it's very important to understand the variations of the contaminants feed water chemistry** and design a system accordingly. Physical chemical processes to remove the iron and silica is typically an oxidation chemical (such as oxygen) and an aluminum-based coagulant such as alum that will precipitate out the iron and silica and allow them to settle so they can be removed in a clarification filtration system.

If you don't have a chemical feeder size large enough, you may get carryover of iron and silica. Or if you're able to precipitate higher, unanticipated volumes of iron and silica, your underflow handling systems such as your sludge thickening and filter pressing operations may not be able to handle the increased amount of sludge.

4. Being unaware of updates/changes to quality requirements

When you design a plant for a certain process and to make sure you meet stringent requirements, sometimes you might find out later you need to **adapt your equipment to account for recent changes in regulations**. This is a common occurrence that sometimes happens after plants have been installed for years. The plant may be running well and designed to deliver a certain kind of effluent quality, and then one day the standards of the quality requirements become more stringent and the plant no longer meets the requirements at the facility.

As an example, let's say you are feeding water to a low-pressure boiler and you put in a bigger boiler that runs at a higher pressure. Depending on the requirements of the new boiler, the quality of the feed water to the boiler might no longer be adequate. **You might need to ensure the feed water is a better quality and add ancillary equipment to the system**.

For this reason, **plants should be designed with some forward thinking** in mind of what might be anticipated.

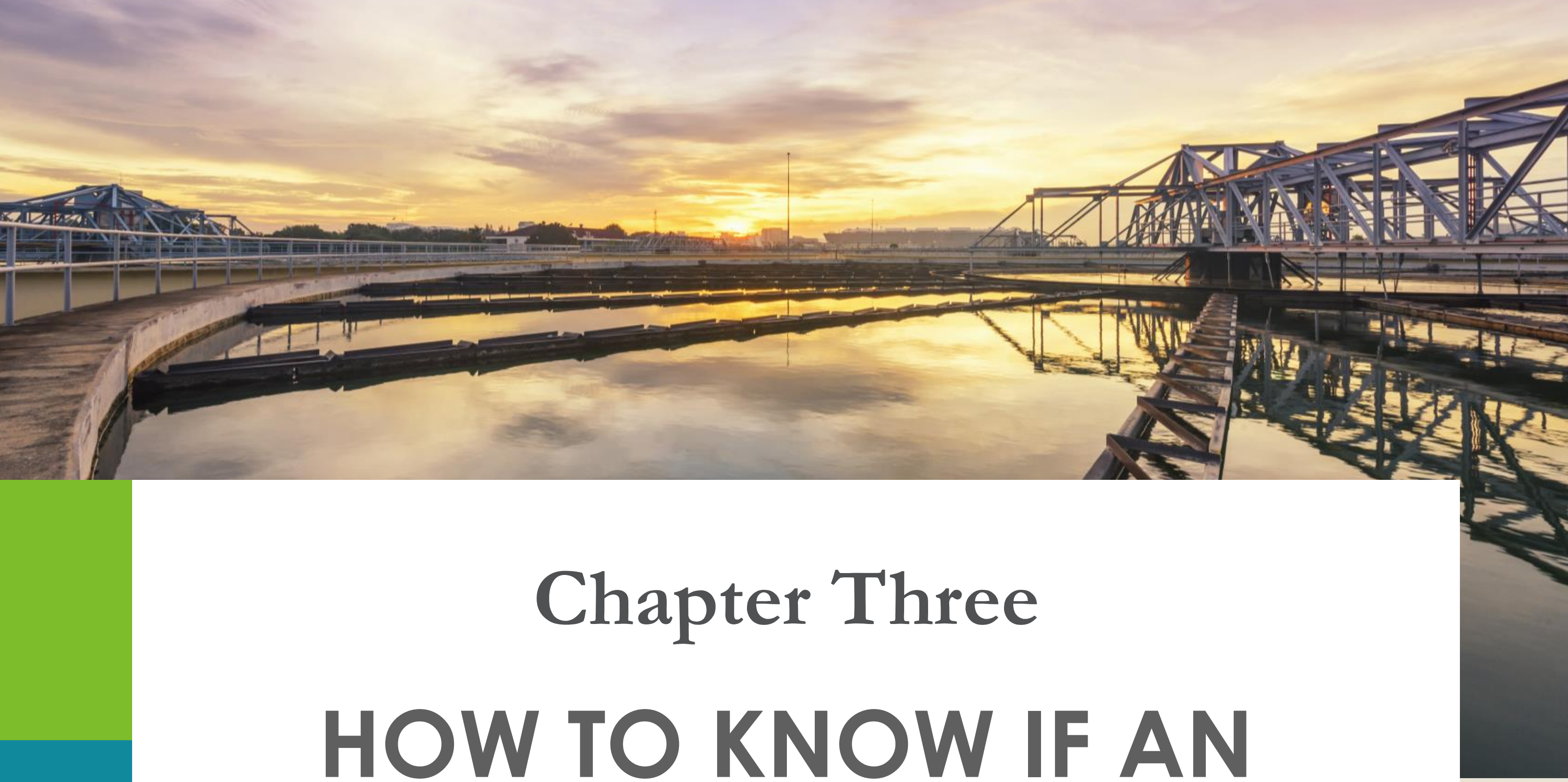
It is also helpful to plant for expansion and quality improvement and allow space in the plant for adding additional equipment to handle changes in quality requirements.

5. Secondary waste

One of the biggest mistakes made in designing raw water treatment plants is **not looking carefully at the secondary waste generated by the process**.

Contaminants from the feed water impact the volume and processing requirements in secondary waste. Also, sometimes these secondary wastes need to be treated and discharged, yet many times they are discharged to a publicly owned treatment works or wastewater facility and they must meet the requirements of that facility.

It's best to **get a copy of the permit requirements, carefully analyze them, and design your wastewater secondary treatment processes and sludge handling to meet the effluent discharge of the plant water to the municipality**. Sometimes this includes releasing to the environment under a SPEDES permit. These permissions need to be negotiated in advance to be sure that the plant will achieve the effluent goals or discharge.



Chapter Three

HOW TO KNOW IF AN INDUSTRIAL FACILITY NEEDS A RAW WATER TREATMENT SYSTEM

DOES YOUR PLANT NEED A RAW WATER TREATMENT SYSTEM?

How to know if treatment is necessary

Determining whether or not you need a raw water treatment system for your industrial facility can be a difficult decision. But if your plant draws from a raw water source (such as a river, lake, ocean, or groundwater), chances are you will need some sort of treatment. If left untreated, what is present in your water source can cause a variety of issues, such as **contamination in drinking water that can make people sick or solids in industrial water feed that can foul equipment and cause costly system downtime**, among others.

Below, we explore the various **reasons you might need to purchase a raw water treatment system for your plant** and look at what ignoring these issues could mean for your facility:

Eliminate foul odors and tastes

For industrial facilities in the food and beverage industry, using a raw water source for water feed to rinse bottles and/or make consumable products, **using untreated or improperly treated raw water can result in foul odors and tastes in products**.

Sometimes foul odors and tastes can be caused by the presence of suspended solids, algae, or iron in your process feed water. The severity of these issues can vary with the turbidity and biological load of the raw water, which may fluctuate with changing seasons and what the best steps are to get there.

If left untreated, these contaminants that cause tastes and odors **can result in a lower-quality product and possible regulatory issues** if your product standards are not meeting industry standards. In general, it's important to know what those regulations might be in addition to whether or not you are currently meeting them.

A well-designed raw water treatment facility will be able to handle a variation in turbidity, especially when it comes to clarification and gravity settling. If you do end up deciding to purchase a raw water treatment system, **slightly over-designing the clarifier and chemical system in the raw water treatment system will allow you to fluctuate your chemical feed in order to deal with the changes in turbidity**. Another option is using UF directly to filter the raw water feed. Since it's an absolute barrier, it handles the seasonal variations effectively, as well.

Remove bacteria

In industrial processes, living organisms can cause all sorts of costly issues with products and industrial processes, especially in the food and beverage industry and potable water uses.

If harmful bacteria, viruses, or cysts are not removed from potable water or water used industrially for rinsing containers or making food-based products, for example, someone who might come into contact with the living organisms can experience all kinds of health issues. If harmful bacteria are found, product recalls are a certainty.

Some of the health threats include:

- Giardia and Cryptosporidium
- Salmonella
- E. coli
- Cholera
- Hepatitis A and E

These short- and long-term health problems could potentially result in large fines for not meeting regulations in the first place.

With the proper raw water treatment system in place, **many of these harmful organisms can be removed** through settling followed by an oxidizing agent such as ozone, peroxide, or chlorine. You can also remove bacteria efficiently with UF, a newer technology being used that is extremely effective.

Avoid scaled and fouled equipment

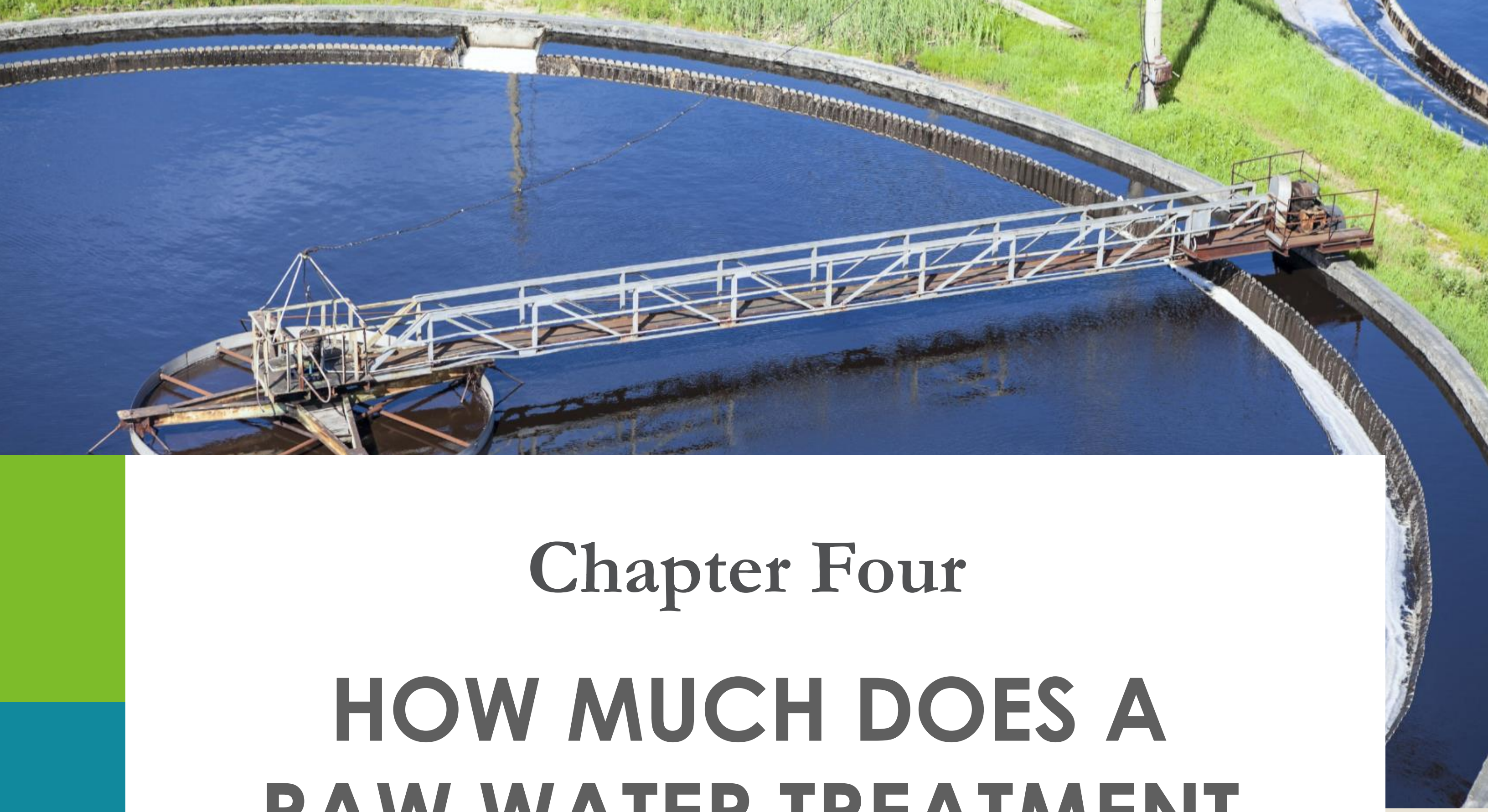
Many times in the cooling tower and/or boiler process, a raw water source is being used to provide the feed water to these pieces of equipment. If the raw water is not treated correctly, **hardness, bacteria, slime, and suspended solids in the water will scale or foul**

the equipment, which can lead to plant downtime and energy loss. When these scale/minerals like hardness, bacteria, slime, and suspended solids are present in the water, they coat equipment fixtures, plug pipes, scale equipment, coat boiler tubes, and cause the formation of sludge, which can all **slow down your process and even cause it to shut down**.

Having an efficient raw water treatment system will help protect your valuable equipment and help avoid these issues in the first place. Most of these solids can be removed in the clarification or UF phase of treatment. Depending on the equipment the water is feeding into, additional treatment with demineralization may be required, but be sure to consult with the company designing your system for their recommendation of what process is the best way to treat your raw water source.

Additional comments

This chapter discusses the general need for raw water. Since water is used in a variety of industrial applications, secondary polishing treatment is typically done specific to the industry and the process feed needs. Chemical, power, pharmaceutical, and food and beverage industries all have the unique water quality needs and regulatory testing requirements, so be sure to reach out to a water treatment specialist for more information on your specific industry.



Chapter Four

HOW MUCH DOES A RAW WATER TREATMENT SYSTEM COST?

HOW MUCH A RAW WATER TREATMENT SYSTEM COSTS

Pricing, factors, etc.

For industrial companies looking to purchase a raw water treatment system for their plant, one of the first things they want to know is, **"How much does a raw water treatment system cost?"** As you might have guessed, the answer to this question can be complex with several factors that go into choosing the right treatment options specific to the needs of the plant.

What's included in a basic raw water treatment system?

As mentioned in a prior chapter, basic raw water treatment system typically includes some type of clarifier to settle out the larger solids, a chemical feed to help facilitate the flocculation or coagulation of any suspended solids, a specific variety of filtration to remove the smaller particles, and, depending on the level of automated operation needed, a control panel of sorts. Depending on the needs of the customer, these standard components are usually adequate, however, if your plant requires a system that provides a bit more customization, there might be some features or technologies you will need to add on.

The main factors of system cost

All in all, there are three main factors that drive the cost of a raw water treatment system:

- ***Quality.*** What is the quality of your raw water source and what are the purity requirements of the treated water?
- ***Quantity.*** What amount of water do you need to process per day and how fast? (This is your required peak gallons per minute, or GPM.)
- ***Plant lifespan.*** How long will you need to run the system? Five years? Thirty?

If you can answer these questions, it will help you narrow down what your needs might be and provide a better sense of the budget you might be looking at.

Let's break down these three main factors and consider how they might fluctuate your system price:

The quality of your water source and the equipment needed to treat it

One of the largest factors that will determine the cost of your raw water treatment system is the equipment that will go into the actual makeup of the system. Will you be using a municipal water source? Are you drawing from a well? Will you be sourcing from an ocean, river, or lake? The complexity of the makeup of your source water in relation to the desired quality of your treated water will determine a lot about the type of system you need.

For example, if a plant needs to treat dirty lake water with lots of algae to a level of purity fit for drinking, the system might require equipment that handles clarification to settle out the larger precipitates, chlorination to disinfect the water enough for drinking, and filtration to remove all the finer particles. At a rate of 100 GPM, you might be looking at **$350,000** for equipment, depending on the details of the system you need and any extra added features.

Another example is an industrial plant that needs to feed their cooling water tower. The plant isn't looking to have their source water treated for potability, but they need all the larger particles and suspended solids removed. A system like this might require a few durable strainers and a holding tank, and at 100 GPM, you might be spending around **$50,000** for your raw water treatment system equipment.

Flow rates in relation to the capital cost of your system

In general, if your plant runs consistently at a lower flow rate, you're usually looking at a lower capital cost for your raw water treatment system. If your plant generally runs a greater flow in a shorter amount of time, your capital cost is usually higher for equipment. Flow rates are always factored into the raw water treatment system cost, so be sure you measure this as efficiently as possible prior to requesting a quote in order to get an accurate cost estimate for your system.

The initial design and expected lifespan of your plant

Another thing to consider when you are looking to purchase a raw water treatment system is the useful life expectancy of your plant. Will the service life span five years? How about 20 or 30? This is important to consider, as this will ensure the system is constructed with the right materials in mind. This can help reduce further costs and change-outs down the road.

For example, if you are a company who is purchasing a raw water treatment system for a temporary job, a system built with PVC and mobile skids might be a better option than something that is constructed permanently from sturdier materials and is meant to last you much longer. For a plant made with heartier materials, such as rubber-lined vessels and stainless steel piping, project costs will be higher initially, but the materials will outlast some of the wear and tear you might see with a system made from PVC. The lower-end PVC system might cost you around **$100,000**, again, depending on the specifics of the project and flow rate, whereas a higher-end system, built to last a bit longer, can run you up to **$500,000** or more.

Other important factors to consider when pricing a raw water treatment system

Upfront planning. The first action you need to take when planning your raw water treatment system is developing the concepts, designs, and regulatory requirements for your project.

The cost of engineering for this type of project can typically run 10–15% of the cost of the entire project. This cost is usually phased in over the course of the project, with most of your investment being allocated to the facility's general arrangement, mechanical, electrical, and civil design.

Space requirements. When planning for a raw water treatment system, the size of your system will affect your cost. For example, if you have small space constraints, technologies that save space, such as an inclined plate clarifier instead of a conventional gravity settler, may be used.

Plant location and land acquisition. When you are installing your raw water treatment system, keep in mind that sometimes your plant location can affect the cost of your system. For example, if your plant is located in a place that is very expensive when it comes to space, you might want to aim for a smaller footprint.

Installation rates. Another thing to keep in mind is the installation rates in your area. These sometimes also fluctuate by location so be sure you're aware of the cost to install the system and factor this into your budget. In areas where installation costs are high you may want to consider prepackaged modules versus build-in-place facilities.

Level of system automation needed. When it comes to the level of automation you need for your raw water treatment system, there are two options. The first is a higher level of automation where you won't need an operator present for much of the time.

This option is more costly upfront (an initial investment in more sophisticated PLC controls and instrumentation), but the ongoing labor costs are less. The second option is a lower level of automation with less capital cost, but with added labor, this can end up costing you more in the long run. When it comes to deciding whether or not to invest in more costly controls, you need to consider what works for your company and staffing availabilities.

***Turnkey and prepackaged systems*.** The larger your project is, the more it makes sense to build the system on-site, however, if you are able to, prepackaging your raw water treatment system will typically save you about three months in construction time at a about the same cost or less. A benefit to having your system prepackaged is that the production facilities and fabrication shops that assemble your system are, more often than not, highly knowledgeable about the type of system they are manufacturing. This results in a quick and efficient fabrication versus build-in-place facilities. Sometimes when you hire a field crew, there is a bit of a learning curve that can add extra time and/or cost to a project. Installation costs will vary, but typically range between 15–40% of the project cost, depending on the specifics of prepackaging and amount of site civil work needed.

***Shipping the system to your plant*.** When you are coordinating the shipping details of your raw water treatment system, you usually want to factor in about 5–10% of the cost of the equipment for freight.

This can vary widely depending upon the time of year you are purchasing your system in addition to where your plant is located in relation to the manufacturing facility. When you are looking to purchase your system, check with your manufacturer to see if there is a facility where the system can be constructed closer to you, if not on-site.

Operation costs. Also keep in mind that particular technology packages cost a certain amount to purchase upfront, but you need to also factor in system operating costs over time. For decisions like these, you need to weigh the pros and cons of initial versus long-term cost investment in addition to what works for your company and staff. You will likely want to look into having someone develop an operating cost analysis so your company can plan ahead for the operating cost over your raw water treatment plant's life cycle. This might help you consider whether or not you want to spend more on your system initially or over time.

Other possible costs and fees. When purchasing a raw water treatment system, you might also want to keep in mind what other hidden costs and fees might be. For example: Will there be any taxes on the system or additional purchasing fees? What are your possible utility costs to the installation area? Will there be any environmental regulatory fees and/or permits? Any ongoing analytical compliance testing you need to pay for? Try to be aware, as best as possible, of all these extra costs that you might need to factor into your budget. For example, does your area have any water source connection fees? Places with highly taxed water sources, such as California with their current drought, might charge a much higher connection fee than areas with abundant water sources.

For more information about connection fees to your water source, check with local regulators. Many times the fee is based on the volume of water your plant requires and varies based on whether you are drawing your water from an open body of water, such as an ocean or lake, or from a well or municipal reserve. If municipal water is your source, chances are there will be a higher fee associated to your water usage, as the municipality will have to reserve a certain amount of water for you to be able to use. You might need to apply for a permit for this as well.

Also consider that there will be costs to treating the secondary waste produced by the system. With stringent environmental regulations, you will need to either treat the waste for discharge or solidify and transport to third party disposal firm.

Be sure to ask your system manufacturer about options that might be cheaper to install. They might be able to shed some light on the more installation-friendly systems with suggestions on how to keep your costs to a minimum.

The bottom line

If your plant has a flow rate of roughly 200 to 1,000 GPM, realistically you are looking at a **$975,000 to $3,000,000** system when you factor in all the needed equipment, engineering, design, installation, and startup.

Chapter Five

HOW TO CHOOSE THE BEST RAW WATER TREATMENT SYSTEM FOR AN INDUSTRIAL PLANT

CHOOSING A FACILITY'S RAW WATER TREATMENT SYSTEM

What to look for when making your decision

The best raw water treatment system for the facility will help it avoid **costly plant downtime**, **expensive maintenance fees**, and **not being able to sell its products in the market**, among other problematic issues.

But **how do you choose the best raw water treatment system for your plant**?

The answer to this question can sometimes be a bit complex and depends on a variety of factors. We've simplified and broken down what this might mean for your plant in the following text.

The main factors to consider when choosing a raw water treatment system

There are three main factors that will help you choose the ideal raw water treatment system:

- ***Quality.*** What is the quality of your raw water source and what are the purity requirements of the treated water?
- ***Raw water testing and treatability study results.*** What are the variations of your feed water chemistry over time and how does this affect your process? Will the proposed treatment options help you solve the issues your seeing and meet local discharge regulations for your secondary wastes generated?
- ***Plant lifespan.*** How long will you need to run the system? Five years? Thirty?

Working with your engineering company to analyze these key points will help steer you in the right direction when choosing the best system for your plant.

Let's break down each factor individually and simplify how these might affect your decisions:

The quality of your raw water source in relation to the quality requirements after treatment

One of the largest factors that will determine how to choose your raw water treatment system is the **equipment that will go into the actual makeup of the system**, which is often determined by the **quality of your raw water source in relation to the quality of water you need after treatment**.

What is the quality of your water source?

The first thing to understand when choosing the best raw water treatment system for your plant is **what your water source will be**.

In all cases, careful consideration should be used in looking at the source water and whether it's best to either use the local **municipally-fed, ground, or surface water**, as they are all affected by different contaminants.

Sometimes it's better to treat your own raw water from ground or surface sources or to buy it from a secondary source, such as a municipality, but either way, it's important to evaluate the quality you're going to get. If the municipal water source is going to give you poor quality water and you have to treat it further to make it useful in your facility when you can access your own better quality surface or ground water, then make sure you're weighing these options. **The contaminants present in the source water in relation to what your water quality needs are will affect the technology present in the makeup of your system**.

What is the quality of water you need?

The second thing to understand when choosing the best raw water treatment system for your plant is **the quality of water you need for your plant**. Does it need to be pure for drinking? Ultrapure for microelectronics production? Not so pure for domestic use such as flushing a toilet or equipment wash down?

Also keep in mind that the **water quality might depend on your industry**. For example, many industrial facilities in industries such as power, petrochemical, chemical, and refineries, require large volumes of water for boiler makeup. Because of this, **care must be taken in selecting the raw water treatment technologies** that will properly prepare the water for polishing treatment such as removing colloidal contaminants from the water, which will foul membrane systems and plug deionizers. Specifically, this can relate to colloidal silica, which will affect the downstream treatment technologies and their ability to run efficiently.

You might also need to consider cold and warm lime softening and silica reduction campaigns such as aluminum-based coagulants . . . or membrane processes to remove colloidal materials and polish with carbon and ion exchange for your required boiler feed. So keep in mind that when choosing your optimal raw water treatment system, your specific process requirements will greatly affect your needs.

Once you've assessed which water source is best and have evaluated the quality of your chosen source, considering the technologies needed to treat your raw water source for your facility to get your water quality where it needs to be for your process will be a bit clearer.

The outcome of a thorough treatability study

A raw water treatability study is a **study or test that will determine *if* the raw water can be treated for your process and *how* it needs to be treated**.

If the study is done correctly, it will clearly identify the problems you're seeing in your feed water stream, helping ensure the proper treatment solutions are considered and implemented in your raw water treatment system.

This step is **critically important** when choosing the best raw water treatment system for your plant. After having a roadmap of maybe two or three technology platforms that meet your base and operating cost, running an efficient treatability test will help validate the assumptions you've made about possible contaminations and solutions to remove them.

Also keep in mind that even though the study might seem thorough on paper, **there's nothing better than running pilot testing in the field to validate the treatment/technology assumptions, optimize design,** because during this phase, other problems can arise and be found prior to choosing the components of your system, which can help save you a lot of plant downtime and costly system equipment change-outs down the line.

How long will you be running your system?

Another factor that will help you determine the technology needed in your raw water treatment system is **the length of time your plant will run**. Will you be up and running for five years? Thirty?

This is important to consider, as this will **help you choose the right materials needed for construction**. For example, if you are a company who is purchasing a raw water treatment system for a temporary job, a system built with PVC and mobile skids might be a better option than something that is constructed permanently from sturdier materials and is meant to last you much longer. For a plant made with heartier materials, such as rubber-lined vessels and stainless steel piping, project costs will be higher initially, but the materials will outlast some of the wear and tear you might see with a system made from PVC.

This can also help you choose the best raw water treatment system by helping you **evaluate the cost of the system**. Many times when selecting a raw water treatment system, it's common to only look at the capital cost. It's important to also consider labor, operating cost, etc., over the lifecycle of the plant, as the least expensive capital cost might not always be the least expensive solution.

Most times the cost of operating the facility is much more than just the capital cost to build it when you're looking at a 10- to 20-year lifecycle. Also, keep in mind that if your facility doesn't have the staff available to manage more advanced technologies, your system choices might be lower in capital cost, but care must be given to bring on board **the right team of individuals who can run the equipment**. Another option is to choose simpler technologies that are within the realm of people who are operating and running the facility.

HOW CAN SAMCO HELP?

SAMCO has over 40 years' experience helping design and engineer some of the most complex raw water treatment systems in the water industry. For more information about what we offer and how we can help, please visit our website or contact us to schedule a consultation with one of our skilled engineers.

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