Compliments of Water Quality Association

WQA Special Edition

Water Treatment

FOR DUMMIES®

A Wiley Brand

Learn to:

- Identify water contaminants and find out how to treat or remove them
- Make a case for adding certified water treatment technology to your home
- Save money and enhance your health and home

Water Quality Association (WQA)

The Water Quality Association is a not-for-profit international trade association for the residential, commercial, and industrial water treatment industry, with more than 2,500 company members worldwide, including equipment manufacturers, suppliers, dealers, and distributors.

WQA is ANSI-accredited for product testing and certification. It offers in-depth education to help professionals and consumers identify effective and safe water treatment solutions.

Since 1977, WQA's Professional Certification Program has helped consumers find informed, ethical, and certified professionals — each earning a three-year certificate by passing an exam on water contaminants and treatment technologies — for sales, installation, and service of water treatment equipment and products in compliance with all regulatory requirements.

Since 1959, WQA's Gold Seal Certification Program has certified, to nationally accepted standards, more than 10,000 drinking water treatment devices and related products via independent third-party laboratory testing.

WQA's Sustainability Certification Mark assures consumers that drinking water-related products are produced according to industry best practices for sustainable manufacturing.

To find WQA Members, WQA-Certified Professionals, or WQA-Certified Products, visit the WQA website at www.wqa.org.

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Table of Contents

Introduction

Water, water everywhere. But is it good and safe to drink or use? How can you tell if the water in your home is healthy for you, your family, and for that prized front-loading washing machine? What can you do if your water doesn't measure up? Read on to find out.

About This Book

Water Treatment For Dummies, WQA Special Edition, answers your water quality questions. This book shows that you have options and tools available to help you take steps to ensure good quality drinking water for you and your family.

Foolish Assumptions

When we wrote this book, we made some assumptions about you. For example:

- You drink and use water every day (well, duh!), and you want that water to be clean and safe.
- You have some say in ensuring the quality of your water — most likely, you're a homeowner.
- You don't want to earn a PhD in water quality — you just want to be able to turn on the tap and be confident in the H_2O that comes out.

Icons Used in This Book

We want to help you soak up the most important points, so we've used handy icons to get your attention.

These sentences are among the most important ones when it comes to understanding your water quality.

You want to make your life easier? Then focus your attention on the item shown here.

We know you don't want a PhD in these topics, but here are extra details you might find interesting.

We're talking matters of health here, so watch out when you see this icon.

Where to Go From Here

Onward, of course! Or backwards! It's your book; read it any way you like. The point is, we've tried to make it easy for you to do just that. Read it all the way through if you want, or skip from here to there to find just the tidbits you need.

Turn to Chapter 1 to find out where your water comes from and how it gets to homes and businesses. Chapter 2 explains the benefits of good water quality. Chapter 3 explains why cleaner or conditioned water is good for you, your appliances, and your budget. Chapter 4 goes over the various options available for your water needs.

Chapter 1

What Is Water, Anyway?

In This Chapter

- Getting water to your tap
- Calculating the cost of water

What is water? Water is a molecule called H_2O that contains two atoms of hydrogen and one atom of oxygen. It's a transparent, odorless, tasteless liquid that you can find in lakes, rivers, and oceans. It falls from the sky as rain or snow.

Water is bottled and sold commercially, but it is also a key ingredient in thousands of products, from lotions and cosmetics to cleaners and beverages.

Where Does Water Come From?

If you're fortunate, water is all around you, in just the right amounts and in the right places. But it didn't just get there by magic. Ultimately, fresh water is the result of the Earth's water or hydrologic cycle (see Figure 1-1). Basically, the sun's heat causes surface water to evaporate. It rises in the atmosphere, then cools and condenses to form clouds. When enough water

vapor condenses, it falls back to the surface again as rain, sleet, or snow. The process repeats itself in a never-ending cycle.

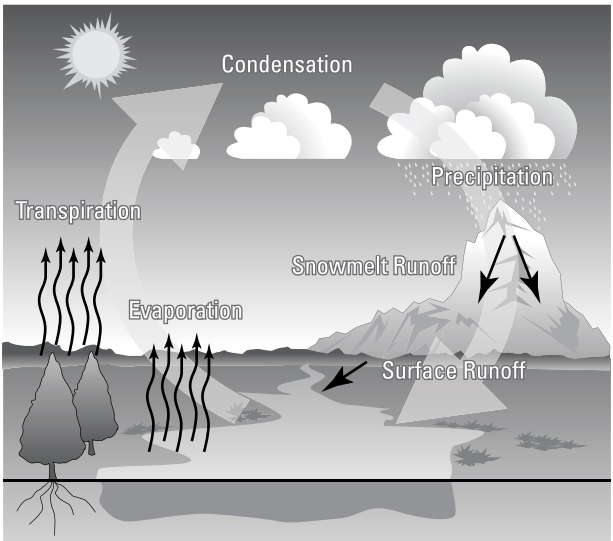

Figure 1-1: The water cycle.

The water we consume and use every day comes from two main sources: groundwater and surface water. Other sources such as snow melt, rain, and recycled wastewater have only limited use, but they're getting more attention these days because of water scarcity issues in dry climates. Just 1 percent of all water is accessible.

Water from the ground

When rainwater or melting snow seeps into the ground, it collects in underground pockets called aquifers, which store the groundwater and form the water table, another name for the highest level of water that an aquifer can hold. Water levels can reach the water table or fall well below it depending on such factors as rainfall, drought, or the rate at which the water is being used. Groundwater usually comes from aquifers through a drilled well or natural spring.

Water on the surface

Surface water flows through or collects in streams, rivers, lakes, reservoirs, and oceans — and not underground like groundwater. Surface water can be beautiful, even pristine-looking, but most of it isn't directly fit for drinking. Fully 97 percent is found in the oceans and can't be used for drinking because of its salt content. The other 3 percent of water is fresh, and most of that is locked up in ice or glaciers.

How Water Gets to Your Home or Business

Typically, pipes bring the water supply from a facility that treats the water to your home or business. A well built and maintained distribution system of pipes helps ensure its quality. Another format to provide water specific for drinking to a home or business would be the installation of a water cooler or the delivery of bottled water.

Treating the water

Water treatment involves disinfecting and purifying untreated ground and surface water. The purpose of a public or private water treatment facility is to make water *potable* — that is to say, safe to drink — as well as *palatable* — good tasting. The facility also ensures that there's an adequate supply of water to meet the community's needs.

Given that many people think of water as something they use to clean other things, how exactly is water itself cleaned through water treatment? Raw and untreated water is obtained from an underground aquifer (usually through wells) or from a surface water source, such as a lake or river. It is pumped, or flows, to a treatment facility.

Once there, the water is pretreated to remove debris such as leaves and silt. Then, a sequence of treatment processes — including filtration and disinfection with chemicals or physical processes — eliminates disease-causing microorganisms. It's a highly complex process, and you'll be glad to know that it's closely monitored for quality control. When the treatment is complete, water flows out into the community through a network of pipes and pumps that are commonly referred to as *the distribution system*.

What's the difference between public and private water treatment facilities? Public, municipal systems are owned and operated by the cities or towns they serve, and they're typically under the management of a mayor or other elected official. Private systems range from individual wells serving a single household, to small corporate associations that provide water to a small group of

homes, or to large corporations that have their own water service divisions. Whether public or private, all U.S. water utilities that serve more than 25 people must adhere to water quality standards established by the U.S. Environmental Protection Agency (USEPA) as well as state and local regulations.

Wells

A well is a strategically placed access point drilled into an aquifer, combined with a pump to withdraw the water and a basic filtering or screening system.

As mentioned, public or private wells that serve more than 25 individuals are subject to the guidelines of the USEPA and other local regulations, but individually owned private wells aren't, which means that the homeowner bears the full responsibility for ensuring water quality. About 15 percent of Americans, most of them in rural areas, rely on privately owned wells.

Through your pipes to the faucet

Whether your water is coming in from a treatment plant across town or the well in your backyard, the final step to access clean water is your home plumbing. If you're connected to municipal water, there's usually a main valve installed where the main line from the distribution system enters the home.

Water from a bottle

Bottled water is popular. Studies suggest that half of all Americans drink bottled water from time to time, and about a third consume it regularly. As with tap water, the source of bottled water is usually a municipal water system or a natural spring, and from there it may go

through additional purification. As a packaged product, bottled water is regulated under the guidelines of the U.S. Food and Drug Administration (USFDA). To find out more, check out `www.bottledwater.org`.

Counting Your Gallons

How much water do you use? If you're a typical U.S. resident, the answer is between 80 and 100 gallons every day. If that sounds like a lot, consider that the total includes not just drinking water, but also the water you use for washing, watering your lawn and garden, and waste disposal.

Quenching your thirst

Of all that water you use, you don't drink that much — people actually drink less than 1 percent of the water coming into their homes. The rest goes for other purposes.

Getting stuff (and you) clean

Water is the universal solvent, because given enough time it can dissolve nearly anything. That means it's great for cleaning, and explains why so much of our water usage is involved in washing one thing or another (or ourselves).

Quenching your plants' thirst

If you have a big yard or a thirsty vegetable garden, you probably already know that watering can really run up your water bill, especially in hot, dry climates.

Water down the drain

Flush a modern toilet and you just used about 1.6 gallons. Got an older toilet? The usage can be as much as 5 gallons per flush.

The Bottom Line

Unless you have your own well, you're likely to have to pay something for the water you use. A typical U.S. household pays about $1.50 per 1,000 gallons, or $0.0015 per gallon. For a family of four using 100 gallons per person each day, that adds up to about $18 per month. Some places are more or less expensive, though.

Bottled water has a higher price tag, although it may be preferred for businesses or homes that want a low-maintenance source of quality drinking water. According to the Beverage Marketing Corp., the wholesale cost of domestic, nonsparkling bottled drinking water was $1.21 per gallon in 2011. Drinking water sold in 20-ounce bottles may cost more than $6 per gallon.

Also, many homeowners have to pay for sewage (water that leaves the home). In the U.S., the average monthly cost for sewage is $84 a month, but depending on the city, it can range from less than $15 to more than $200.

Chapter 2

Benefits of Good Water Quality

In This Chapter

- Keeping healthy
- Maintaining appliances
- Listening to the EPA
- Ensuring that your water is clean

Understanding the effects of poor water quality can help you appreciate the benefits of good water quality.

Water and Health Are Linked

According to the Centers for Disease Control and Prevention (better known as the CDC), the top causes of disease outbreaks related to drinking water are *Giardia* intestinalis, hepatitis A, norovirus, and *Shigella*. Bad as that sounds, it's far from a complete list. There are also health risks related to water contaminated with organic and inorganic matter, other bacteria and viruses, and other pollutants.

Some studies link high levels of lead in drinking water to delays in physical and mental development, short attention spans, and learning difficulties in children. There's also evidence that arsenic in drinking water can lead to

nerve, heart, skin, and blood vessel damage. And *Cryptosporidium* is responsible for potentially life-threatening diarrhea.

Still, water is essential. The human body is, after all, 70 percent water, and although a human being can survive a month or more without food, a week without water can be fatal.

Yes, bad water is bad for you, but safe water is key to life — and good for you! Water has so many health benefits that the CDC recommends drinking eight 8-ounce glasses of water a day. It is not hard to meet this, if you recognize that hydration can be achieved in various formats such as the water cooler at work, public drinking fountains, or the tap at home.

Good for Appliances, Too

Good water is good for your home and appliances, too. A 2009 study commissioned by the Water Quality Research Foundation (WQRF) and conducted by the Battelle Memorial Institute found that adding a water softener helps water heaters and major appliances operate as efficiently as possible, while preventing clogs in showerheads, faucets, and drains.

For example, researchers ran dishwashers and washing machines for 30 days and 240 wash cycles. They ran softened water through half of the units, while using a hard water source for the others. At the end of the month, the washers using softened water were nearly free of scale buildup, but the washers using hard water required scale removal to work well.

As for water heaters, the researchers found that when they used softened water, the units maintained their original factory efficiency rating for as long as 15 years. Running hard water through the units cut efficiency by up to 48 percent. Scale buildup shortened the lifespan of the heating elements inside electric water heaters, and some tankless water heaters using hard water failed after just 1.6 years!

The researchers found that showerheads performed well on soft water, but those running with hard water lost 75 percent of their flow rate in less than 18 months. When running hard water through faucets, the strainers on the faucets clogged within 19 days.

Softened water can save you money by keeping appliances at top efficiency, and making them last longer. The amount of dish and laundry detergent you use can be cut by half, or even more, if you use softened water. You can also lower wash temperatures from hot to cold without a drop in performance, according to two other independent studies.

Studies conducted by the independent test firm Scientific Services S/D, Inc., of New York, showed that using softened water can:

- Reduce detergent use by 50 percent in washing machines and save energy by making it possible to wash in 60°F cold water instead of 100°F hot water, while achieving the same or even better stain removal along with whiter clothes.
- Achieve the same cleaning results in dishwashers while using less than half the detergent.

Save appliances, save money, and save the planet, too. If you're using less energy to heat (softened) water, you're reducing your carbon footprint. And if you're using less detergent, that means less is going down the drain, reducing harm to the environment.

The USEPA Talks Sense

The USEPA WaterSense program helps you save water and protect the environment. Look for the WaterSense label (see Figure 2-1) on products for your home, yard, or business. To earn WaterSense certification, a product or service must be at least 20 percent more efficient than other similar products without any loss in performance.

Figure 2-1: The recognizable WaterSense label.

An independent, third party certifies WaterSense-labeled products to meet USEPA standards for water efficiency and performance. WaterSense certifies showerheads, toilets, faucets, irrigation systems, urinals, and more.

Look for a complete, searchable list of products at `www.epa.gov/watersense/product_search.html`.

Is it worth the trouble? Yes. According to the USEPA, if one of every ten homes installed a WaterSense faucet, it would save about 6 billion gallons of water per year and more than $50 million in energy costs. And that's just one faucet in a tenth of all homes! Imagine how much water and energy could be saved if more homes took action.

Water Quality Tips

We've talked about water quantity and reducing usage. What about water quality?

Keep your water filters clean

If you have a filter to remove contaminants, maintain it according to the manufacturer's specifications. This might include cleaning it, replacing filter cartridges, and sometimes calling in a professional for service. Filters overdue for cleaning or replacing may no longer work properly to remove contaminants and may let foul tastes and odors remain in your tap water.

Wash water containers regularly

You can have the best water treatment in the world, but if you put clean water into a dirty container, it may no longer be safe or palatable to drink. It's critical to

properly and regularly clean water containers, from household pitchers to water bottles.

Mix a few drops of dish detergent into clean water and pour it into the storage container. Agitate the liquid, and scrub the inside with a nonabrasive scrub brush or a clean dish rag, then rinse the container thoroughly. If you want to achieve a higher level of cleanliness, disinfect the container with a mixture of unscented chlorine bleach and water. Mix it according to instructions on the bottle, and then swish the mixture around inside the container to ensure that it hits every surface. Leave the mixture inside the container for about 30 minutes, and then thoroughly rinse with tap water.

Maintain your water softener

A typical water softener uses resin beads to capture hardness ions, and periodically uses salt to cleanse the beads and prepare the unit to remove more hardness ions. If you have a basic system, check salt levels at least once a month; it's easy to do. Just lift the tank lid and look inside; if the tank is less than half full, add more salt. Or find a water professional at `www.wqa.org`, and have them check and maintain it for you.

Chapter 3

What's in Your Water?

In This Chapter

- Understanding water purity
- Diagnosing your water
- Examining the regulations

Know what's in your water, so, if a problem is found, you can do something about it.

How Pure Is Pure?

Your water isn't just molecules made up of two parts hydrogen to one part oxygen, or H_2O. *Pure water* is a relative term because almost all the water you'll encounter contains minerals, impurities, contaminants, and microorganisms. These substances may be present in incredibly tiny amounts, and they don't necessarily have negative health impacts. Some of them might impart the flavor you expect from water — if you drank pure H_2O, you might not even like it.

Knowing your household water has stuff in it besides just plain H_2O, the USEPA has created standards that enable water to be classified as potable water, even if it does have traces of

other elements in it. Of course, these standards require that the water be free of disease-causing microbes, and also require it to be clear, palatable, odorless, noncorrosive, and free of any other objectionable particles or gases.

Water gains other ingredients in many ways. Acid rain, industrial waste dumping, runoff from storms, and pesticides can contaminate surface water. Contaminants may come from older combined sanitary/storm sewer systems that overflow during wet weather. Groundwater might be contaminated by chemicals leaching into soil from landfills, septic systems, or improper disposal of agricultural or household chemicals.

Water can become impure after it leaves a treatment facility, and it can even pick up some additives from the facility itself. Most municipalities add chemicals such as fluoride, chlorine, or chloramines to treated water, to help protect your teeth and to keep the water free of harmful germs on its way to your tap. Beyond that, silt, sediment, and other minerals can build up inside water mains and household plumbing. When a water main breaks or is repaired or replaced, it's possible for silt, sediment, and microorganisms to enter the system. Sediment can also build up in your own hot water tank, introducing more contamination. Corrosion of pipes can add metals such as lead and copper to water.

Diagnose Your Water

There are many ways to find out what's in your water and whether it's safe. Below are tips.

The most obvious possibilities

Your first diagnostic tools are your senses. You can, at times, see, taste, smell, and feel contaminated water.

Use your eyes

When artists show water in landscape scenes, they often make it blue or blue-green. But you wouldn't want water that color coming out of your tap. Quality water, when you view it up close, is clear and colorless.

Water that is red, orange, yellow, brown, or cloudy can signal iron, rust, or other contaminants in the mains or your household plumbing. Tannins from decaying vegetation and leaves can also give water a yellow or brownish hue.

Manganese may make water appear brown, red, orange, yellow, or even black. Iron may give it a reddish-orange cast, or it might even have a yellow, tealike appearance.

Like that scenic painting or photo, water might have blue or green in it. That may indicate the presence of copper, possibly coming from corroded plumbing. You might also see blue or green water if there's corrosion of the bronze alloys in pumps and valves, a sign that there also may be zinc in the water.

If your water has these issues, try to identify the source. Consider these tips for sleuthing.

Contamination from water mains will most likely show up in these three ways:

- Clear water suddenly becomes discolored.
- Cold water looks discolored but hot water looks clear.

- Discoloration from faucets continues even after the water has been running for a few minutes.

Or, if the issue comes from your home plumbing, there are two ways that it will reveal itself:

- There's discoloration after the water hasn't been run for a few hours.
- The water runs clear after a few minutes.

Follow your nose, trust your tongue

Stinky or bad-tasting water are signs of impurities.

Here are common water odor or taste problems you might encounter:

- A rotten-egg or sulfur smell or taste suggests the presence of hydrogen sulfide. That's often caused by a certain type of bacteria in the water. Sulfates can also cause the water to taste salty. Investigate further to pinpoint the source, such as bacteria growing in drains, water heaters, wells, or on the inside of pipes.
- Musty, earthy odors and tastes may signal dissolved solids. Such aromas and tastes may be caused by decaying organic matter in the plumbing or even in the source water itself.
- Then there's the smell and taste of chlorine. It's there for disinfection to make water safer to drink and originates during the normal chlorination treatment process, but to enjoy the taste you may want to get rid of it.
- If water smells or tastes like turpentine or other chemical (yikes!) that might indicate the presence of MTBE (short for methyl tertiary butyl ether) or

xylenes, byproducts of gasoline refining, paints, detergents, or inks.

- Metallic smells and tastes may be a sign of mercury, lead, copper, arsenic, or iron in the water. Manganese and zinc may also cause a metallic smell or taste. These chemicals may come from the pipes themselves.

Diagnosing stains and deposits

It isn't just the water that can be discolored. Discoloration of surfaces can also be a sign of impurities.

Got bathtub rings or white scale, spots on dishes and cutlery, or deposits on clothes coming out of the wash? Those are signs of hard water or excess total dissolved solids (experts call these TDS for short) in your water. The biggest culprits in hard water are calcium (limestone) and magnesium. TDS can include all minerals, salts, or metals dissolved in water, and might include plant material.

The invisible contaminants

It's bad enough to be able to see, smell, or taste a contaminant. But what if your water looks, smells, and tastes just fine — is it? Not necessarily.

Microbial and organic contamination

Microbial and organic contaminants aren't always seen, smelled, or tasted. You might go years before realizing a problem exists. Many folks never become suspicious until people in the community start to get sick.

Although some waterborne microbes can cause illness, many microbes are harmless or even beneficial. Very small levels of microbes

are naturally present in many water supplies, but some are more dangerous than others. Some of the more dangerous microbial contaminants, such as *E. coli, Giardia,* and *Cryptosporidium,* can cause gastrointestinal problems and flulike symptoms commonly attributed to undercooked or improperly stored food.

To kill or remove these microbes, water treatment facilities often use chlorination. Problem is, disinfection chemicals such as chlorine are reactive and can combine with other substances in water, such as natural organic chemicals and bromide compounds, to form hazardous byproducts such as bromate, chlorite, haloacetic acids (HAA5), and trihalomethanes (you might hear them described as total trihalomethanes or TTHM). The USEPA says that long-term exposure to these hazardous chemicals can increase the risk of illnesses such as cancer and anemia, along with liver, kidney, and central nervous system problems.

Water near agricultural areas may contain harmful organic material from pesticide or fertilizer application. Chemicals from pesticides and fertilizers in water may increase cancer risk and reproductive problems, and can impair eye, liver, kidney, and other body functions. Similar problems can result from exposure to water near industrial plants.

Inorganic and mineral substances

There are still more possible pollutants in water. These include:

- **Nitrates and nitrites:** Sometimes found in small amounts in well water in agricultural areas; they can make infants and others ill
- **Arsenic:** A natural well water contaminant thought to contribute to skin damage, circulatory system issues, and increased cancer risk
- **Lead:** From some plumbing fixtures and pipes, and known to impair physical and mental development in children, contribute to kidney disease, and cause high blood pressure in adults
- **Mercury:** Usually from industrial pollution, possibly contributing to kidney damage and more

At low levels typically found in water, these substances are invisible, odorless, and tasteless, but nevertheless harmful.

Taking the test

The USEPA's Safe Drinking Water Act requires municipalities to test water supplies once, twice, or several times per year, depending on the potential contaminants and the size of the population served. But just because the water has been tested, you can't necessarily assume that all is well.

The Safe Drinking Water Information System produces a report titled *Annual Public Water System Statistics.* The report cites thousands of violations across the country, violations that affect millions of people each year. Likewise, the CDC reports that outbreaks caused by water quality issues lead to more than 4,000 illnesses every year. More than half of these illnesses were related to untreated or inadequately treated groundwater, says the CDC.

Water that leaves the treatment facility can become contaminated by the time it shows up at your tap.

Municipalities don't continuously monitor the water pipes that transport water to homes.

Also, in some cases, home well water hasn't been tested in years, possibly not since the well became active. No standards govern the testing of private well water. There are rules in certain places — some states or the USEPA recommend annual testing, and in some cases require testing when a home or business is sold. Otherwise, private well water quality is largely undefined and unmonitored.

The Consumer Confidence Report (CCR)

If your home is served by a public water system, get a copy of your municipality's CCR. Community water systems (those providing service to more than 25 people or 15 households) are required by the USEPA to issue a CCR every year, usually at the beginning of July. The report details what contaminants, if any, exist in the water supply and how these contaminants might impact health.

The CCR informs consumers about the source of their drinking water, details recent water quality testing results, then compares the results to the USEPA's health-based standard. The document also provides info about *Cryptosporidium* and lead, even if these contaminants aren't found in the water supply.

If your CCR states the water is considered safe, and yet it still tastes, smells, or looks bad, you may wish to do further testing

through a certified water-testing laboratory. You can check with the Water Quality Association (WQA) to find a water quality professional (`www.wqa.org`) or connect with a certified water-testing lab to test your water (`http://water.epa.gov/scitech/drinkingwater/labcert/statecertification.cfm`).

Is My Water Hard or Soft?

Water hardness refers to the level of certain minerals, particularly calcium and magnesium, found in your tap water. Hard water causes both aesthetic and usage problems, such as spots on dishes or sink fixtures, scale buildup on showers, tubs, sinks, and toilets, and poor soap lathering. It can clog pipes over time, increase the energy for heating water, and damage internal parts of household appliances that use water.

The unit for measuring water hardness is grains per gallon, or gpg. Table 3-1 is a simple chart from WQA showing what these numbers mean.

Table 3-1 Water Hardness Classification

Grains Per Gallon (gpg)	*Hard or Soft?*
Less than 1.0	Soft
1-3.5	Slightly Hard
3.5-7.0	Moderately Hard
7.0-10.5	Hard
10.5-above	Very Hard

Is My Water pH Neutral?

It's possible for water to be acidic, or the opposite, basic. Or, it could be in the middle — neutral, which is desirable. Acidic or basic water is measured on the pH scale.

What Do You Call Safe?

The USEPA has been in charge of the quality of U.S. drinking water since 1974, when the Safe Drinking Water Act (SDWA) passed. This law requires the USEPA to set standards for drinking water quality and monitor whether states, local municipalities, and water suppliers are in compliance.

The Safe Drinking Water Act (SDWA)

Under the SDWA, the USEPA sets limits on levels of certain contaminants in drinking water. It also sets standards for testing schedules and test methods, and determines which water treatment processes are acceptable. The SDWA, however, doesn't regulate private wells that serve fewer than 25 individuals.

Regulating the byproducts of disinfection

In 1998, the USEPA began requiring public water systems to use treatments that reduce the formation of disinfection byproducts. Specifically, the rule regulates hazardous chemicals such as TTHM, HAA5, bromate, and chlorite.

Microbial regulations

The USEPA's Surface Water Treatment rule focuses on pathogens or disease-causing microorganisms in drinking water. Under this rule, a public water system must have treatment sufficient to reduce water concentrations of *Giardia* and other pathogens. The ruling sets limits on disinfectant residuals and turbidity, which is water discoloration or cloudiness from the particles suspended in water. The USEPA's list was later expanded to include *Cryptosporidium* and other harmful microorganisms in water, and acceptable levels of disinfection byproducts were lowered.

Chapter 4

Finding the Right Water Treatment Products

In This Chapter

- Solving your water problems
- Finding the right people and products
- Examining green treatment options

You often know when your water is "bad." It smells, doesn't lather your soap, has a funny taste, or comes out of the faucet in odd colors. Or, perhaps water testing has detected contaminants of concern. What do you do next?

Condition Your Water

Whether your water is hard or contaminated, there are effective water treatment technologies ready to help. Water conditioning is the treatment of water to modify, enhance, or improve it so it meets a specific water quality need, desire, or standard. Or just call it water treatment. There are many different treatment technologies that get the job done.

Exchanging ions to make water softer

Ion exchange water softeners are among the most common ways of softening water. The typical ion exchange system consists of a pressure tank filled with sulfonated, polystyrene beads that are capable of removing hardness ions from water, and replacing them with softer ions, such as sodium. These units are connected to a brine tank that's filled with salt, which periodically regenerates the resin beads.

The unit's tiny beads attract and hold onto calcium and magnesium ions as water passes through them. When the beads become so saturated they can't hold any more, the unit rinses them with salt, which scrubs off the mineral deposits and gets them ready to absorb hardness ions again.

If you've got this type of water softener, you can set it to regenerate at preset times, or if it's a bit more sophisticated, it can base regeneration on your actual water use. Systems that measure water use and regenerate accordingly, called *demand initiated regeneration (DIR),* may be more efficient because they only regenerate as needed. Systems that automatically regenerate on set time intervals, called *time clocks,* certainly simplify the process. But sometimes these regenerate more often than necessary, wasting salt, or they leave users with hard water when water demand is higher than normal.

Filtration may be the answer you need

Although water softeners get rid of some heavy metals along with hardness, water filtration systems are the best way to remove

organic and inorganic materials such as microbiological contaminants and particulates such as sand, rust, or silt. Water filters remove these impurities with a fine physical barrier, chemicals, or some other method to help clean water and make it suitable for drinking or other use.

There are many filtration solutions available; they generally fit into two categories.

Point-of-Use

Point-of-Use (POU) devices treat water at the point of consumption. The technology provides the *final barrier* to the contaminants of concern before the water is consumed or used. Among the choices are:

- **Gravity devices:** Such as countertop pitchers that use carbon filters.
- **Inline filters:** Packed with filtration media or membranes and installed in, or perhaps underneath, a sink.
- **Reverse osmosis units:** Installed on, in, or underneath a sink.
- **Ultraviolet (UV) technologies:** Uses light to deactivate pathogens so they can't grow and reproduce.
- **Distillers:** Turns water into steam and back again and in the process gets rid of nearly all kinds of biological pathogens and a host of contaminants.

Appropriate final barrier treatment can reduce chemicals like:

- Disinfection byproducts
- Corrosion products (for example, lead) from the distribution system and home plumbing

- Disease-causing microbes
- Trace levels of endocrine disruptors, personal care products, and pharmaceuticals

Point-of-Entry

Point-of-Entry (POE) devices are whole-house treatment systems mainly designed to reduce contaminants in water intended for showering, washing dishes and clothes, brushing teeth, and flushing toilets. Options include:

- **Water softeners:** Discussed in the "Exchanging ions to make water softer" section.
- **Sediment and tank filtration systems:** Removes contaminants as water enters the home.
- **Large inline filtration systems:** Installed where water enters the home plumbing system.
- **Final barrier systems**: Sometimes used by municipalities to supplement or even replace centralized water treatment facilities. These systems do the treatment at the location of the end user, which means contaminants that are picked up between the treatment plant and the home are no longer a problem. (See previous section for more about this technology.)

Choose filtration media guided by the specifics of your situation. For example, you may need a system that uses greensand media. It's good for getting rid of contaminants such as hydrogen sulfide. As with the resin beads in a water softener, many types of media need recharging or replacement from time to time.

Activated carbon is a widely used filtration substance that targets various volatile organic compounds, such as benzene, trichloroethylene, and various pesticides and petroleum-related compounds. Maintenance is as simple as swapping out a cartridge once or twice a year. Activated carbon may be granular or in a solid block. Some carbon block filters can have greater filtration capabilities that can remove lead, asbestos, and some microbes out of the water.

You also may choose ceramic or synthetic fiber microfilters, which can sift out tiny contaminants including various microbes and tiny sediment particles.

Moving forward with reverse osmosis

Sometimes shortened to the acronym RO, these systems force water, under pressure, into a module that contains a semipermeable membrane and a number of other filtration steps. A typical RO system has a prefilter designed to capture larger particles, chlorine, and other substances; a semipermeable membrane that captures more contaminants; an activated carbon filter that removes residual taste, odor, and some organic contaminants; and a storage tank to hold the treated water for use.

You can get a whole-house RO, but more commonly, a point-of-use RO system would be on your countertop or installed under the sink. They're great for treating water for cooking and drinking, but they don't usually produce large amounts of treated water — more like 3 to 10 gallons a day. For that reason, typically people choose to install RO-treated faucets in the most popular areas of

the home such as kitchens and bathrooms, as opposed to installing it for every drinking tap.

Just like any other kind of filter technology, reverse osmosis systems require regular maintenance. That includes periodically replacing the unit's prefilters, postfilters, and membrane modules.

Distilling purer water

Distillation is one of the oldest water-purification methods around. Distillation will effectively remove minerals, most chemicals, and many bad tastes from tap water. These systems heat water until it reaches its boiling point and begins to vaporize, and then feed the vaporized water into a condenser that cools the steam and converts the water back to liquid form.

A vent to discharge gases is a common feature, and these units may also include an activated carbon filter to pull out even more contaminants. Most home distillers produce only small amounts of treated water daily. They require periodic cleaning and descaling to remove mineral buildup.

Disinfection is a clean choice for private well systems

Water disinfection is just what it sounds like — it gets rid of the stuff that's infecting the water. It removes, deactivates, or kills microorganisms, viruses, cysts, and bacteria. If water wasn't disinfected, it would likely contain disease-causing agents that would make a lot of

people sick. Municipalities disinfect water at the water treatment plant. Consumers in homes with private wells must disinfect water themselves.

There are both chemical and physical ways to disinfect water. Chemical disinfection often uses halogens such as chlorine, iodine, bromine, or ozone, while common physical choices are ultraviolet (UV) light, ultrafiltration, and distillation. These processes can eliminate anywhere from 99.9 to 99.9999 percent of harmful microorganisms.

Ultraviolet light (UV)

The UV disinfection method, which doesn't involve chemicals, has long been popular for commercial use, and it's becoming more common in homes. UV systems expose water to light at just the right wavelength for killing microbes. It's a way to kill bacteria, viruses, fungi, protozoans, and cysts that may be present in the water.

How effective it is depends on the strength and intensity of the light, the amount of time the light shines through the water, and, of course, the quantity of particles in the water in the first place. The light source must be kept clean and the UV lamp replaced periodically.

UV light treatment can't remove gases, heavy metals, and particulates, and for that reason higher-end systems may include additional filtration such as activated carbon. If so, that means you'll need to occasionally clean or replace those filters or perform other maintenance.

Chlorination

This method of disinfection involves adding chlorine to water to make it safer to drink. It's common, cost-effective, quick, and effective, killing many pathogenic microorganisms. It can even oxidize or break down iron, manganese, and hydrogen sulfide, which can result in water that is clearer and tastes better.

Some people find that chlorine gives water its own objectionable chemical taste and odor. It also can produce disinfection byproducts (which may cause health issues) by reacting with other substances in water when stored. These byproducts can often be filtered out with activated carbon.

Ozone

You get ozone when you expose oxygen to high-voltage currents. Introduce ozone into the water treatment process, and you'll destroy viruses, bacteria, and other microorganisms, and also remove iron, sulfur, and manganese. Ozone does its job quickly and then rapidly decomposes, and that cuts down on the introduction of harmful disinfection byproducts and foul tastes or odors associated with chlorination. This process tends to be more costly and energy-consuming and is typically used commercially or by large municipalities.

Newer ideas for treating your water

Do you like cutting-edge technology? That may be a great idea when buying phones, TVs, or cars, but you should think twice about purchasing water treatment products before national testing and certification programs are in place to validate claims. Find out more about these programs later in this chapter. Here are

some of the latest concepts for treating your water along with notes about what to consider before a purchase.

Antiscaling treatment

Antiscaling treatment isn't new, but it's new for household use. These types of devices may use magnets, conductive ceramic plates, or even citric acid, to attract, disrupt, or remove hardness ions. Because they're new to the home, there aren't many conclusive studies about the efficacy of these devices for home use, and there aren't yet national standards for testing and certifying antiscaling device performance.

Until product testing for household antiscaling products is available, consumers can't tell for certain which products best reduce scale buildup in the home. Although some of these products may work at the industrial level, water quality varies from house to house, making antiscaling much harder to consistently work for individual homes. Furthermore, even if mineral scale doesn't build up, some of these products don't remove hardness, which means they might leave a residue on surfaces, or the feel of water may be undesirable. Investigate product claims prior to making a purchase.

Standards and protocols are in development that may offer testing and certification of these household products in coming years. Keep an eye on antiscaling technologies such as:

- Template-assisted crystallization that uses surface-treated resin beads to convert (not remove) hardness ions to scale-resistant forms.

- Electrochemical demineralization used in point-of-entry devices to remove hardness ions and other dissolved solids through electrochemical means.
- Capacitive deionization, which is an electrostatic process that removes hardness and other compounds.
- Electrically induced precipitation that uses a direct electrical current to precipitate water hardness and other compounds.

Alkalizer/ionizer

These systems are relatively new, with sparse and potentially inconclusive studies verifying claims, and you'll have a difficult time finding peer-reviewed medical literature and national standards regarding the health effects of alkaline water. Be sure to thoroughly review claims that are made. Performance of carbon or reverse osmosis features can be tested and certified, but health effects of alkaline water can't be tested and certified to national standards. So, be cautious if there isn't robust science backing up claims.

When to Seek Professional Help

If you've noticed your water has a bad taste, smells, doesn't lather, leaves scale or spots on surfaces, or if you've had lab testing done and you aren't sure how to solve the problems, it's time to contact a water quality professional. A pro can help you sort through options because water is complex, has many potential contaminants, and there's no "one size fits all" when it comes to water treatment.

After finding a reputable water quality professional, be sure you're getting a high-quality treatment system, based on what you and your advisor decide you need.

Fortunately, there are ways to determine both the quality of the product and the professional (see Chapter 5 for a list of questions to ask when searching for a water quality professional).

Finding a water quality professional

The Water Quality Association, which has more than 2,500 company members, is a not-for-profit international trade association representing the residential, commercial, and industrial water treatment industry. Its membership consists of both manufacturers/suppliers and dealers/distributors of equipment and services. WQA is a resource and information source, an educator of professionals, a laboratory for testing, a certifier of products and professionals, and a means for helping the public make the best choices.

The WQA was founded in 1974 and started offering certification of water treatment professionals in 1977. It sets standards for water treatment businesses and equipment installers and promotes ethical selling practices among those offering water quality solutions. Professionals earn a three-year certification by meeting strict criteria, passing an exam on water chemistry and treatment technologies, and abiding by a strict code of ethics and legal requirements.

To find WQA-Certified Professionals or WQA-Certified Products, visit the WQA website at `www.wqa.org`.

Finding the Best Products

WQA provides third-party certification — notably its Gold Seal (see Figure 4-1) — for products consumers can buy for water treatment. This program, after decades in existence, is the oldest third-party testing and certification program in the water treatment industry. The Gold Seal is easily recognizable and informs consumers that products are safe and work properly.

The Gold Seal Program is accredited as a reputable certification agency in the United States and Canada by ANSI (American National Standards Institute) and SCC (the Standards Council of Canada). Other accredited certifiers include NSF International, CSA Group, UL (Underwriter Laboratories), and IAPMO.

Figure 4-1: The WQA Gold Seal.

Manufacturers and suppliers can seek Gold Seal certification for most products that contact household water. Certification covers everything from chemicals to plumbing components to filtration systems and water softeners.

Product certification indicates a third-party organization has monitored the manufacturer's operations to ensure they meet guidelines for manufacturing processes and materials used. Products are tested to ensure compliance with industry standards, performance, and certification requirements.

Standards are detailed and rigorous and specific to the products certified. Some standards cover UV disinfecting systems, for example, while others ensure that reverse osmosis systems perform as claimed. Certification also helps verify that manufacturers have good customer service measures in place and offer adequate product literature or information.

Once companies go through this demanding process, they can't rest on their laurels. They must retest their certified products regularly and submit to annual facility inspections.

There are more than 10,000 Gold Seal-certified products. Search for desired products on the WQA website at `www.wqa.org`.

Greener Water Treatment

WQA also has a Sustainability Mark (see Figure 4-2) to help consumers select greener water treatment products that help ensure safe drinking water while showing sensitivity to the environment.

Products earn the mark only after they demonstrate best practices in manufacturing for sustainability. Rigorous examination is required to audit and assess the manufacturer according to independent standards

developed by a WQA task force of environmental experts, consultants, regulators, manufacturers, industry professionals, and other stakeholders.

Figure 4-2: WQA's Sustainability Mark.

Chapter 5

(More Than) Ten Questions to Ask a Water Quality Professional

In This Chapter

- Questions to ask

Before you choose and install a water treatment system, here is another tool to help in your quest. This chapter contains- a list of questions to ask your water quality professional.

- Are you a WQA-Certified Water Specialist, WQA-Certified Sales Representative, or a WQA-Certified Installer?
- Do you have a contractor's license, business license, and liability insurance (if these things are required in your area)?
- How long have you been in business, and who can I call for a referral?
- What do my water testing results show?

- How do I know that the test results cover the main contaminants of concern for my home? Could you be missing something?
- Do these results indicate health hazards in my water?
- Do the water quality issues in my home require whole-house treatment, or will I be okay with a single-tap or other Point-of-Use device?
- Will the device you're recommending treat enough water to accommodate my family's needs?
- What is the total purchase price, and how much more can I expect to pay to maintain the system year in and year out?
- Will you be installing and servicing the device? Is that free, and if not, what will it cost?
- Can I maintain the system myself? Will you show me how to do this?
- Has a third-party organization certified the performance of the products you offer?
- What type of warranty comes with this product?
- How will I know if the equipment is operating correctly?
- What secondary effects might this water treatment unit have on my water quality? Any byproducts?
- Will you provide free follow-up water testing a few months after installation to ensure that the equipment is doing its job?

FOR ADDITIONAL

Consumer Information

Visit www.wqa.org

Find a Water Professional

- Locate WQA member professionals in your area by searching via company name, state, province, zip/postal code, or country.

MEMBER Water Quality Association

- Find WQA water professionals who have demonstrated a certified level of professional expertise and a dedication to high industry standards.

PROFESSIONAL CERTIFICATION Water Quality Association

Find the Best Products

- WQA provides Gold Seal certification of water treatment products. The Gold Seal is easily recognizable and lets consumers know at-a-glance that products are safe and work as they're supposed to.

TESTED AND CERTIFIED Water Quality UNDER INDUSTRY STANDARDS

- WQA's Sustainability Mark helps consumers select greener water treatment products that help ensure safe drinking water while showing sensitivity to the environment.

CERTIFIED FOR WQA SUSTAINABILITY

Water Quality Association

International Headquarters & Laboratory
Lisle, Illinois USA

www.wqa.org

Find out how to ensure water quality, identify problems, and solve them!

This little book can help you understand common water quality problems. Find the facts on water treatment technologies and how to find an effective partner to solve any water problems you find.

- ***Know modern water treatment options* — more than just water filters and softeners**
- ***Get to know current and emerging technologies* — what they do and how they may benefit you**
- ***Understand what makes water better for your home and wallet* — and find out how to select WQA-Certified products that work**

Open the book and find:

- **How to achieve cost-effective water treatment**
- **A list of proven technologies as well as new ones**
- **What you need to know to find the right products**
- **How to find a qualified professional**

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