I'm not robot

reCAPTCHA

Continue

Water pollution lecture notes pdf

According to the Environmental Protection Agency, more than half of the nation's streams and rivers are contaminated, and of these, 19% are reduced by the presence of excess nutrients. The term nutrient refers to dietary sources that support the development of the body. In the context of water pollution, nutrients generally consist of phosphorus and nitrogen that algae and aquatic plants use to grow and multiply. Nitrogen is present in abundance in the atmosphere, but not in a form that is available to most living beings. When nitrogen is in the form of ammonia, nitrite, or nitrates, however, it can be used by many bacteria, algae, and plants. In general, it is the overabundance of nitrates that causes environmental problems. Some common agricultural practices lead to excess nutrients in water systems. Phosphorus and nitrates are important components of fertilisers used in agricultural sectors – they are present in both synthetic fertilisers and natural fertilisers such as manure. If crops don't get all the fertilizer applied, or if rain has a chance to wash it off before it is absorbed by the plants, excess fertilizer is flushed into the streams. Another important source of nutrients also comes from the way in which agricultural sectors are used only seasonally. Most crops are present in the fields during a relatively short growing season, and the rest of the year the soil is left exposed to the elements. Meanwhile, soil bacteria celebrate the decomposing roots and debris of plants, releasing nitrates. Not only do bare fields cause sediment pollution, but this practice allows for the mass release and washing of nitrates. Sewage can transfer nutrients to streams and water. Septic systems, especially if older or improperly maintained, can leak into streams or lakes. Households associated with municipal waste systems also contribute to nutrient pollution. Wastewater treatment plants sometimes operate incorrectly and are periodically overwhelmed during intense rain events and release sewage into rivers. Stormwater. Rain falling in urban or suburban areas gets nutrients from lawn fertilizer, pet waste, and various detergents (for example, soap used to wash someone's car in the driveway). Rainwater is then infiltrated into municipal sewage systems and released into streams and rivers, loaded with phosphorus and nitrogen. Burning fossil fuels releases nitrogen oxides and ammonia into the air, and when deposited in water, can contribute significantly to the excessive nutrient problem. The most problematic are coal-fired power stations and gas or diesel-powered vehicles. Unnecessary nitrates and phosphorus encourage the growth of aquatic plants and algae. Nutrient-enhanced algae growth leads to massive algae blooms, visible as a bright green, stinking sheen on the surface of the water. Some of the algae that make up the blooms produce toxins that are dangerous to fish, wildlife, and humans. The blooms eventually die, and their decay consumes a lot of dissolved oxygen, oxygen, low oxygen concentrations. Invertebrates and fish are killed when oxygen levels sink too low. Some areas, called dead zones, are so low in oxygen that they become empty from most lives. A notorious dead zone is formed in the Gulf of Mexico every year due to agricultural runoff in the Mississippi River basin. Human health can be directly affected, as nitrates in drinking water are toxic, especially for infants. Humans and pets can also become quite sick from exposure to toxic algae. Water treatment does not necessarily solve the problem, and can actually create dangerous conditions when chlorine interacts with algae and produces carcinogenic compounds. Cover crops and fundless agriculture protect agricultural fields and mobilise nutrients. Cover plants die out in winter, and the next growing season gives back those nutrients to the new crop. Maintaining well-vegetated buffers around farm fields and next to streams allows plants to filter nutrients before entering the water. Keep septic systems in good working order, and conduct regular inspections. Review your nutritional inputs from soaps and detergents, and reduce their use whenever possible. In your yard, slow down water runoff and allow it to be filtered out of plants and soil. To achieve this, establish rain gardens, keep drainage ditches well-vegetated, and use rain barrels to harvest roof runoff. Consider permeability on your driveway. These surfaces are designed to let water permeate the soil below, preventing runoff. Environmental Protection Agency. Nutrient pollution. U.S. tap water is some of the cleanest on Earth, generally safe from the germs and chemicals that have plagued people's water supplies for millennia. While much of the planet relies on meager and/or contaminated drinking water, Americans can fill a glass with a relatively low risk of cryptosporidium, chromium or chlordane. That wasn't always the case, however - and in many parts of the country, it still isn't. More than 45 years after the first Earth Day ushered in a new era of environmental awareness, millions of Americans are still drinking dangerous tap water without even knowing it. The U.S. government had virtually no oversight of the quality of drinking water before the 1970s, leaving the job in a patchwork of local laws that were often weakly enforced and widely ignored. It wasn't until Congress passed the Safe Drinking Water Act in 1974 that the The U.S. Environmental Protection Agency (EPA) could set national limits on certain impurities in tap water. Congress later strengthened the agency's powers with amendments in 1986 and 1996. But despite four decades of work that made U.S. tap water safer in general, a flood of hazards still lurk beneath the surface. This includes long-standing threats such as lead, the ongoing danger of which has been highlighted in recent years by the plight of residents in Flint, Michigan. It also includes a number of newer, lesser-known chemicals, many of which are subject to government regulations. In a 2009 report, the EPA warned that threats to drinking water are increasing, adding we can no longer take our drinking water for granted. And in 2010, the nonprofit Environmental Working Group (EWG) issued a landmark report warning that chromium-6 - a potential carcinogen for humans made famous by erin Brockovich's 2000 film - is prevalent in at least 35 U.S. cities' water supplies. The EWG continued to monitor this issue in 2017 by reporting that chromium-6 was detected in drinking water supplies serving more than 200 million Americans. In 2016, a Harvard University study found unsafe levels of polyfluoroalkylic and perfluoroalkylic substances (PFAS) - industrial chemicals linked to cancer, hormone disorder and other health problems - in the drinking water of 6 million Americans. The Safe Drinking Water Act covers more than 90 pollutants, but tens of thousands of chemicals used in the U.S., including more than 8,000 monitored by the EPA, and many of their health effects remain unclear. Studies have linked a number of unregulated chemicals to cancer, hormonal changes and other health problems - and even some regulated ones haven't had their standards updated since the 1970s - but no new pollutants have been added to the list since 2000. As regulators struggle to maintain decades of halting progress in cleaning U.S. tap water, countless Americans will inevitably drink unsafe water much in the future - both from unregulated pollutants and regulated ones that make past water treatment plants. Not all of these pollutants will be dangerous, and even some that are can only cause mild stomach pains, or it can take years to show any results. But since peeling off into uncertainty will be a slow process, here's a quick look at what we know about American water supplies and the pollutants that plague them. Water treatment used to just include filtration, but now disinfectants are added to kill any germs that might have made it over filters. Niruti Puttharaksa/Shutterstock How does pollution get into U.S. water supplies at all, since tap water has to go through water treatment plants first? Most contaminants are filtered out or killed with disinfectants, but treatment plants are not foolproof, and there are ways for business germs and chemicals to either slip through or bypass plants altogether. protection of tap water means combating two interconnected battles: one against pollution as it enters waterways and the other against contaminated water when it reaches a treatment plant. The Clean Water Act of 1972 is the country's main tool for controlling source water pollution, but the law is limited by enforcement issues and legal ambiguity about which water bodies govern. Most U.S. water systems feed off groundwater - which is usually cleaner than surface water as it is filtered out of soil and rocks - but major cities tend to rely on rivers and lakes so that more Americans use it systems, although they represent a fraction of the country's total water portfolio. This makes the work of the processing plants even more important. A typical water treatment plant uses the following five steps to clean so-called raw water before delivering it to customers: Coagulation: As raw water flows into the treatment plant, it is first mixed with alum and other chemicals that form small, sticky particles called floc, which attract bits of dirt and other debris. Precipitation: The combined weight of the dirt and floc becomes heavy enough to sink to the bottom of the tank, where it settles as sediment. Clearer water then flows to the next step in the process. Filtration: After removing larger dirt particles, water passes through a series of filters designed to clear smaller stowaways, including some microbes. These filters often consist of sand, gravel and charcoal, mimicking the natural soil filtration process that usually keeps groundwater clean in nature. Disinfection: Water treatment is used to finish with filtration, but disinfectants have been added during the modern era to kill any germs that could have made past filters. Usually, a small amount of chlorine is added to filtered water, although other disinfection chemicals can also be used. Storage: Once disinfectants are added, water is placed in a closed tank or tank to let the chemicals work their magic. Eventually, water flows from its storage area through pipes to homes and businesses. This range of safeguards is a daunting challenge for most pollutants, especially when chlorine is thrown into the mix. But the intrusions still happen - one of the most notorious was a 1993 cryptosporidium outbreak in Milwaukee, Wisconsin, that sickened 400,000 people and killed more than 100. When natural waterways are heavily contaminated, certain chemicals or microbes may pass through poorly constructed, maintained or operated treatment plants, and in other cases, a treated reservoir may be directly contaminated by rainwater runoff, illegal discharge or accidental leaks. Even the disinfection chemicals themselves can threaten public health in quite large quantities. The Cuyahoga River in Cleveland caught fire in 1969 due to sewage and industrial waste. (Photo: U.S. National Oceanic And Consumer Administration) It wasn't the first time The U.S. river had caught fire - the Cuyahoga itself had already burned nine times since the Civil War, including a 1952 inferno that cost $1.5 million - but it came at a time when environmental issues were already in the spotlight. President Richard Nixon founded the EPA a few months later, and the first Earth Day took place the following April. Within five years, the Clean Water Act and the Safe Drinking Water Act were both signed into law. EPA rules have since stifled overt water pollution such as floating oil chemicals are burning in Cuyahoga, but scientists have also grown increasingly concerned about subtle toxins that were not on the radar 40 years ago. While we have cut off the flow of many conventional pollutants to our tap water sources, we now face challenges from other pollutants from less conventional sources, former EPA Administrator Lisa Jackson said in a March 2010 speech announcing a new EPA water plan. It is not the visible oil spills and industrial waste of the past, but the invisible pollutants that we have only recently had the science to detect. There are a number of chemicals that have become more prevalent in our products, water and body over the last 50 years. These thousands of chemicals are the great unfinished business of the 1974 Act. Even as the EPA works to control this new generation of impurities, however, many Americans are still not entirely safe from the latter. Most U.S. water providers comply with federal regulations and are legally required to report their compliance status to customers, but isolated risks are not uncommon. (The EPA has also acknowledged under-reporting problems with drinking water violations, suggesting that the actual number is even higher.) Pollutants currently governed by EPA regulations fall into five main categories: Microbes: Before the days of synthetic chemicals and oil spills, bacteria and viruses were the main dangers lurking in the water supply. Lakes, rivers and streams are home to a wide variety of microbes, some of which can wreak gastrointestinal havoc if they enter people's bodies. While treatment plants now remove most of them, they are known to pass, as in the Milwaukee outbreak in 1993. Small private wells face higher risks as the EPA does not regulate them, especially in rural areas where animal manure is mixed with runoff, sometimes contamining the groundwater supply of a well. Disinfectants and by-products: Chlorine is the main disinfectant used to treat US drinking water, but treated water may also contain disinfection by-products such as bromic acid, chlorite and haloacetic acid. Chlorine is toxic to humans as well as germs, and while small amounts make tap water safer, too can have the opposite effect - causing eye and nose irritation, stomach discomfort, anemia, and even neurological problems in infants and young children. Bromate, aloxic acids and a class of by-products called total trihalomethane have also been linked to liver and kidney problems, as well as a higher risk Inorganic chemicals: Along with microbes, inorganic chemicals are one of the oldest water pollutants in the world, but humans have also helped spread them. Arsenic (pictured) has a long history of poisoning wells as it erodes from natural deposits, but today it is also in runoff from orchards and in waste from electronics manufacturers. Metals such as copper, lead and mercury can be washed out of natural deposits, too, but today they are best known to leak from corroded corroded emitted from mines, factories and refineries. Many have serious neurological effects, too, especially in children. Nitrogen-rich runoff from farms is another growing threat, causing not only baby blue syndrome, but also algae blooming behind aquatic dead zones. Organic chemicals: The busiest category of EPA-regulated impurities is that for organic compounds, which include a wide range of synthetic chemicals from atrazine to xylolia. Because most artificial chemicals are relatively new compared to ancient metals such as lead and mercury, our knowledge of their health effects is often unclear at best. Many are believed to cause cancer or disrupt the endocrine system, while others have been involved in everything from cataracts to kidney failure. Although organic chemicals account for the largest number of regulated pollutants, thousands of others have not yet been regulated at all. Radiation: Although it is a less widespread and urgent concern than many pollutants, radiation is another powerful carcinogen that can understand water supplies without dropping its hand. Radioactive atoms, known as 'radionuclides', are mainly a natural water pollutant, derived from natural deposits of radium, uranium and other radioactive metals. Drinking radiation-tinged water over time is a major risk factor for cancer, similar to gas radon breath, which is often trapped underground after drifting above the ground below. Things like arsenic, E. coli and PCB are known water impurities, but another potential threat is often overlooked by the public - underground injection, an industrial practice that involves blasting high-pressure liquids into deep underground wells. It dates back to at least 300 AD, when it was used in China to extract salt from deep deposits, and today it is often used in mining, drilling, waste disposal and to prevent saltwater invasion near coasts. The EPA has limited authority to regulate injection wells, first administered by the Safe Drinking Water Act and later since 1986 amendments to the Law on Resource Conservation and Recovery; the idea is to avoid toxic releases without burdening U.S. energy production. One of the most controversial types of underground injection is a method known as hydraulic fracturing, or simply fracking, which has become a common technique to boost production from oil and gas wells. After a well has been drilled into a rock, a liquid (usually water mixed with nitrogenous chemicals) is injected at high pressure, extending deep fractures in the rock that are then filled with a support agent (usually sand suspended in chemical to keep the cracks from closing as soon as the pressure is released. New, wider cracks then allow oil or gas to flow more freely on the surface, improving the productivity of the well. Fracking is hotly debated for a few reasons - it can cause earthquakes, for example, and is part of an unsustainable investment in fossil fuels - but much of the controversy has focused on how affects the water supply. There is little complete evidence to show how much fracking chemicals end up in groundwater, and drilling companies are not required to disclose what chemicals they inject into their wells. However, there are extreme anecdotes - such as a house in Corsica, Pennsylvania, that exploded in 2004 due to methane in its water pipes, killing three people - and growing complaints about boomtowns' energy across the country. In Pennsylvania alone, there have been dozens of cases of methane migration over the past decade, often resulting in natural gas stirring from a home's taps. After years of resisting pressure to crack down on fracking, the EPA announced in 2010 that it would launch a major study into how the practice affects water supplies - part of the agency's broader push to improve U.S. water quality, including stricter rules on mountain removal mining in Appalachia. In 2015, the EPA initially reported no evidence that cracking systematically contaminates water, though an update in 2016 added that the EPA found scientific evidence that hydraulic fracturing activities can affect drinking water resources under certain conditions. More research is still needed, an EPA official told the New York Times at the time. Some wonder if it is smarter and safer to drink only bottled water. Daniel Orth/flickr With so many potential threats to tap water, is it smarter to just buy bottled water? Many Americans seemed to think so throughout the 1990s and early 2000s, but the economic and environmental costs of bottled water are now widely considered to exceed the slim chance of being poisoned by the kitchen sink. For one, bottled water is often little more than packaged tap water anyway, since many companies use the same municipal water sources that provide homes and businesses. Even if the company treats the water further before bottling, the accumulated cost of buying bottles is a steep price to pay for no guarantee the water is safer. And, of course, the main argument against water bottles is more about the bottles themselves – almost always made of plastic, not biodegradable, and unless recycled, they accumulate in landfills, streams, storm drains and beaches, often finding their way to the Great Pacific Ocean Garbage Patch (or other garbage patches). While bottled water has won praise for offering a sugar- and calorie-free alternative to sodas in convenience stores and vending machines, it keeps some water in a head-to-head comparison to the tap, given much higher cost of bottles. Not only is the majority of U.S. tap water safe, but municipal water providers are required by the Safe Drinking Water Act to give their customers a Right to Know report detailing what impurities are in their water. For anyone concerned about the quality of local drinking water, this is a good place to start. If local water isn't up to snuff, home water filters can offer a more sustainable option than water bottles. A wide range of products are available, from small-scale faucet filters to home reverse osmosis reviews. The latter may be expensive, but while smaller purists from companies like Brita or Pur may be a better deal, their filters need to be maintained properly. Neglecting them can allow mildew to grow, defeating the purpose of trying to clean your tap water, which was probably cleaner before it passed through an mildew filter. Image creditsBacteria: USDA Agricultural Research CenterArsenic Ore: Encyclopedia BritannicaRadiation trefoil: US Nuclear Regulatory Commission