

AIM: What causes the buildup of chemicals in living things?

Chemical Solubility	
<p>1. water soluble</p> <ul style="list-style-type: none"> - dissolves in water - spreads easily through body - usually excreted in urine 	<p>2. oil (fat) soluble</p> <p>accumulate in lipid (fat) deposits in body</p>

Bioaccumulation - increase of the concentration of a chemical in the organs or tissue of an organism

Biomagnification

- a. fat-soluble toxins get passed up through food chains
- b. apex predators (top of food chain) have higher concentrations of toxins
- c. can also get passed on to offspring

Examples of Bioaccumulation/Biomagnification with Mercury

Adapted from John Brennan; April 25, 2017

Both elemental mercury and most mercury compounds are highly toxic to humans and other animals. To make matters worse, these compounds build up in living organisms. Animals higher up on the food chain ingest mercury in the tissues of organisms they eat. As a result, these animals can be exposed to very high concentrations of these environmental poisons.

Bioaccumulation is the buildup of mercury and mercury compounds in individual organisms. Mercury is found naturally at very low levels in ocean waters. It is introduced into the environment by **natural events** such as **volcanic eruptions and forest fires**. **Burning coal** and other human activities can also pollute the environment with these compounds.

Bacteria play an important role by converting mercury to a related compound called methylmercury. Both mercury and methylmercury are toxic, but methylmercury is much more dangerous, because it's much easier for organisms to absorb.

Bacterial conversion is a major pathway for elemental mercury to get into the food chain. It tends to build up over time in organisms that are continually exposed. Predators or herbivores that eat contaminated organisms take in the methylmercury their prey contained; animals farther up the food chain are exposed to higher and higher concentrations; this is a process known as biomagnification.

Fish

Predatory ocean fish are other common examples of mercury bioaccumulation and biomagnification. Mercury in ocean water enters plankton, which become food for small fish. These small fish are in turn eaten by larger fish such as swordfish and sharks. Although nearly all fish contain traces of mercury, some predators such as sharks can contain mercury at concentrations a million times higher than the ocean water they inhabit. For this reason, the FDA recommends that pregnant women avoid eating shark, swordfish or king mackerel flesh.

Birds and Otters

Fish-eating birds are another common example of mercury bioaccumulation. Birds such as loons, osprey, herons and certain eagle species eat ocean or freshwater fish. These fish rely indirectly on plankton that contain mercury they absorbed from the surrounding waters. As a result, Otters and other mammals that prey on fish are also vulnerable to high levels of mercury in the environment for similar reasons.

Minamata Disease

The tragic 1950s mass poisoning in Minamata, Japan is the most infamous example of mercury poisoning. The Chisso Corporation factory located in Minamata used mercury as part of a process to manufacture acetaldehyde. The factory dumped the methylmercury-rich waste into the bay, where it accumulated in fish.

“For years, residents of Minamata, a town located on Kyushu (Japan’s most southwesterly island), had observed odd behavior among animals, particularly household cats. The felines would suddenly convulse and sometimes leap into the sea to their deaths — townspeople referred to the behavior as “cat dancing disease.” In 1956, the first human patient of what soon became known as Minamata disease was identified. Symptoms included convulsions, slurred speech, loss of motor functions and uncontrollable limb movements. Three years later, an investigation concluded that the affliction was a result of industrial poisoning of Minamata Bay by the Chisso Corp., which had long been one of the port town’s biggest employers. As a result of wastewater pollution by the plastic manufacturer, large amounts of mercury and other heavy metals found their way into the fish and shellfish that comprised a large part of the local diet. Thousands of residents have slowly suffered over the decades and died from the disease. It has taken as long for some to receive their due compensation from the corporation.” (Gilbert Cruz, Time Magazine May 03, 2010)

AQUACULTURE – NEW AND REVIEW

1. farmed fish are not as “healthy” as wild varieties
2. high population density leads to unsanitary conditions (eutrophication, disease spread,) sometimes resulting in the use of antibiotics ←can lead to disease resistance
3. fish are fed pellets that are not as healthy as their normal diet in the wild
4. fish can escape and pass on diseases/parasites as well as interbreed with fish in the wild