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Acid Rain Issues

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"Acid rain" has made its way into the headlines of newspapers and magazines as a major environmental issue, maybe the big environmental challenge in the coming decades.

Yet most Texans associate the acid rain issue solely with the northeastern portion of the United States, Canada, and industrialized western Europe.

Might it be possible, however, that acid rain is also a problem right here in Texas?

The acid rain situation is not yet so serious that fish kills and the death of lakes have been reported, as is the case in some of the more severely afflicted areas.

Still, two reports prepared by the Texas Energy and Natural Resources Advisory Committee (TENRAC) and the Texas Air Control Board (TACB) state that the potential for an acid rain problem may exist in parts of Texas.

They indicate that "acid rain," or more specifically acid deposition, is not a problem for most of Texas, but that the potential for a problem exists, particularly in Northeast Texas.

TENRAC's two-volume report, "A Plan to Evaluate Acid Deposition Issues in the State of Texas," was issued in January of 1982 and is one of the most comprehensive and up-to-date documents on the acid rain situation in Texas.

The TACB published a research division staff report, "Analysis of Texas Acid Rain Data," in August of 1984. It presents the current acid rain situation in the state.

Basic Facts about Acid Rain

Acid rain is a very complex phenomenon which is still not completely understood.

In basic terms, acid rain is just one of a variety of means by which acidic substances are deposited upon the earth. These depositions could be either wet (including acid rain, fog, or dew) or dry (dust and gases).

Depositions are grouped according to their acidity with a pH scale, which has a low pH value of O and a high pH value of 14. Acidic substances have low pH values (battery acid is pH 1) and alkaline substances have high pH values (Iye is pH 13).

The pH scale is logarithmic, so that a solution with a pH of 1 is ten times more acidic than another solution with pH 2 and is 100 times more acidic than something with a pH of 3. A pH of 7 is neutral. Substances with a pH over 7 are alkaline, while items with a pH of less than 7 are acidic.

Acid deposition can affect vegetation, soils, surface water, aquatic ecology and human health.

Acid deposition can produce sulfate and nitrate fertilization which may be beneficial to vegetation. If the pH values are too low, however, there can be negative effects. Short-term effects may include leaf and stem damage, a disruption of the plant's normal breathing process, and blemishes on fruits and vegetables. Toxic substances like aluminum, manganese, and iron may also be introduced into the soil. Long-term exposure of vegetation to acid depositions can lead to increased plant susceptibility to pests and diseases.

Some crops are especially sensitive to the negative effects of acid deposition including cotton, soybeans, oats, alfalfa, peas. green beans, squash, and tomatoes. Sensitive native plants, specifically Spanish moss and Bracken fern, may be early indicators of potential acid rain problems.

Acid deposition may also have a negative impact on soils. The acidification of soils is a natural process which occurs continuously. Contributing to the process are the decomposition of dead plants and biological decay. Adding acidic fertilizers may accelerate the process.

In excessively alkaline soils and in well-buffered soils, acid deposition has a positive effect because it contributes sulfate and nitrate fertilizers. In poorly buffered soils, acid deposition accelerates the natural acidification process. In extreme cases, it may lead to soil contamination, phytotoxicity and heavy metal contamination of groundwater.

Acidic substances may also enter surface water systems through atmospheric deposition and surface runoff. Whether or not these acidic substances affect water quality depends

on the alkalinity of the existing surface water and soil, and the composition of bedrock of the watershed. In lakes and streams subject to acidification, water quality suffers from increased acidity. This may lead to increased concentrations of heavy metals, especially aluminum, which can be toxic to fish at relatively low levels and which can render phosphates unavailable for aquatic life.

Acid deposition can also affect aquatic animals and plants, once changes in water quality occur. The results of high concentrations of acids and heavy metals affect all links of the food chain, including bacteria, phytoplankton and zooplankton and can even affect predator-prey relationships.

In fish, the effects of water acidification may include failure to spawn, low serum calcium levels in females spinal deformities, and even the disappearance of some species.

There are no confirmed direct or indirect effects of acid deposition on human health. Indirect effects have been theorized to exist due to the release of toxic materials, which can enter the human body through the consumption of contaminated fish, plants, or water. Acidic water can even become contaminated by leaching materials from household plumbing.

Acid deposition can accelerate the decay of stone and metal surfaces including limestone, concrete, sandstone, and lime and can accelerate the corrosion of copper, zinc, brass and bronze. Effects on iron, steel, and lead have also been observed, and even automobile finishes degenerate when exposed to acid deposition.

Sources of Acid Rain in Texas

In Texas, there are four main sources of airborne material which contribute to the pH of rainwater. These are in-state manmade sources, out-of-state manmade sources, natural sources along the Coastal Plains and windblown soils.

Acid deposition which comes from manmade sources is usually the result of nitrogen oxide emissions and sulfur dioxide emissions. Emissions source inventories prepared by the TACB show that industrial fuel consumption, transportation (including automotive emissions) and electrical power generation were the most common sources of nitrogen oxide emissions in Texas. The most common sources of sulfur dioxide emissions were from industrial sources in the petroleum and mining industries, and from coal and lignite-fired electrical generation plants.

Approximately half of the state's nitrogen oxide and sulfur dioxide emissions come from an area east of a line drawn from Corpus Christi through the Dallas-Fort Worth area and to the Red River.

The TENRAC report states that eastern Oklahoma, Arkansas and Louisiana probably contribute to the acid deposition burden in Texas, because of the proximity of their industrialized areas to Texas. Emissions from Mexico may also contribute because of less stringent emissions controls in that country.

Natural sources in Texas may also have an impact. Salty air from the Gulf of Mexico and coastal marshes, as well as sulfur emissions from coastal marshes and mudflats are potential contributors to the acid deposition budget.

Alkaline soils from West Texas, which are wind blown across the state, may have a buffering effect. This is especially true if they carry lime, fertilizer dust, and ammonia, which producers often add to the soils.

Texas weather may also have an impact on the acid deposition situation in the state. Higher evaporation rates in Texas may increase the potential for damage to vegetation, but the low frequency of rainfall may increase the importance of dry deposition. Lack of snow cover, however, diminishes the potential for an acid shock due to spring thaw.

Impacts of Acid Rain on Texas

Texas can be divided into three geographic areas based on each area's vulnerability to the impacts of acid rain. The region west of a line drawn from Corpus Christi through the Dallas-Fort Worth area appears to be virtually immune from all negative impacts of acid deposition. The area south and east of a line drawn from Corpus Christi to Waco to the Toledo Bend Reservoir produces much of the acid emissions in Texas and has the lowest levels of pH recorded in the state (as low as 3.0 in Houston). Even this area appears to be susceptible to only some of the negative impacts of acid deposition.

The northeast corner of Texas north of Lufkin and east of Dallas is the region of the state most susceptible to potential negative acid deposition impacts. The most sensitive area is near Longview. Vegetation and soils there are particularly vulnerable to acid depositions, and acid precipitation has been observed at every monitoring site in this area, although surface waters have not yet been adversely affected.

Soils in northeast Texas are probably the most vulnerable to negative effects of acid depositions in the state. Oak and pine forests and boggy wetlands, both of which can be found in northeast Texas, are particularly vulnerable to acid deposition. Soils in the region are poorly buffered and sandy, allowing acids to move easily through the ground and flow into lakes and streams.

A preliminary analysis of four East Texas streams indicates that negative effects of acid deposition have not been observed and are probably unlikely to occur in the near future. The TENRAC report stated that the Angelina River could be susceptible to acid deposition effects in the future.

Acid Rain Monitoring in Texas

Monitoring for acid depositions in Texas on a consistent basis has begun only within the last few years. Precipitation pH was first monitored in Texas in 1959 at Amarillo, Brownsville and San Angelo, with other early monitoring efforts in the late 1960s and early 1970s occurring in Houston, Austin, San Angelo and Victoria. At present, a number of acid deposition monitoring programs are either in operation or about to begin operation in Texas. Preliminary data indicate the presence of routinely acidic

precipitation throughout most of Northeast Texas, although the precipitation in West Texas appears to be mostly alkaline.

The TACB has operated rainfall event monitors since 1979 at Beaumont, Odessa and Tyler. It began monitoring at Fort Worth in 1980 and at Longview in 1982. The World Meteorological Organization (WMO) has a monitoring station at Victoria, and the National Atmospheric Deposition Program (NADP) monitors at Victoria, Nacogdoches and the Big Bend National Park. Additionally, a NADP site at Longview is operated by the TACB, and the Utility Acid Precipitation Study Program (UAPSP) monitors at Marshall.

The WMO, NADP and UAPSP monitor wet deposition, which is removed on a weekly basis.

The TACB monitors only during precipitation events. Field pH and conductiveness measurements are made, then samples are sent to TACB laboratories for analysis.

The TACB data for 1983 demonstrate current pH measurements in the state. They show that Longview had the lowest pH values in Texas among the sites listed. Longview sites reported an average pH of 4.37, with pH values ranging from 3.72 to 6.01. Average pH values around the state included Beaumont (5.80), Fort Worth (5.63), Tyler (4.79), Nacogdoches (4.93), Big Bend (5.23) and Marshall (4.65).

Previous studies by various groups are also noteworthy. The cities of Houston, Dallas and San Antonio conduct periodic monitoring and have found predominantly acidic deposition in Houston and mildly acidic deposition in Dallas.

Progress is being made on reaching a consensus of ideas as to what should be done about the acid deposition issue.

The 1984 TACB report endorses many of the following recommendations made in the TENRAC study:

- A single government entity be designated to monitor acid depositions.
- Monitoring precipitation chemistry in the state be continued, modified and expanded.
- A survey of potential effects of acid deposition be conducted in Houston and Longview.
- Advances in the state of the art in monitoring dry deposition be followed, with the idea of tracking dry deposition in Texas.
- Studies of ultimate causes of acid deposition in Texas be implemented.

Acid deposition is not yet a problem in Texas. The potential for a problem does exist in the Northeast, however, and the acid rain issue deserves continued public attention.