Department of Environmental Protection
Wastewater Operations and Assistance
Energy Efficiency

Basics

Current is the flow rate of electrons. Current is measured in amperes (amps or A). Voltage is the pressure behind the electrons. Voltage is measured in volts (V). Electric power is measured in watts (W). A watt of power is available when one ampere of electricity passes through a pressure of one volt. Most of the time electric power is referred to in terms of kilowatts (KW). A kilowatt is 1,000 watts.

Generators can produce both alternating current (AC) and direct current (DC). With direct current, the electrons travel in only one direction. The electrons in an alternating current reverse direction at regular intervals. Transmitting direct current is much more difficult than transmitting alternating current. In the United States electric is supplied as an alternating current at 60 cycles per second or 60 Hertz (Hz).

Understanding an Electric Bill

The electric bill from the power company is comprised of many charges. Each charge is based on the Rate Schedule or tariff for your facility. A brief description of each charge is provided below.

- The **energy charge** is based on the total kilowatt-hours (KWh) used. Kilowatt-hours is the unit of electricity measured by the electric meter. For example, a 100 watt light bulb burning for 10 hours would be 1,000 watt-hours or 1 KWh.

- Energy demand is the rate of kilowatt-hours used over a specified time period. The **demand charge** is based on a fifteen-minute interval. For example, twenty 50-watt light bulbs are turned on at the same time and kept on for 15 minutes. In this case, the energy use would be 0.25 kilowatt-hours and the demand is 1000 watts or one kilowatt. If the lights are left on for one hour, the energy use is one kilowatt-hour and the demand is still one kilowatt. Now, let ten of the lights on for one hour and then have the other ten lights turned on for one hour. In this example, the energy use is still one kilowatt-hour, but the demand charge is only 0.5 kilowatts.

- The **reactive charge** is measured in kVars. Power factor is the relationship between the energy being supplied and the energy being effectively used. Facilities with poor power factor use up capacity. The result is the power companies must compensate with added equipment and larger power plants. A kVar charge is a fair way to make facilities with lower power factors pay for their share.

- **Other Charges**:

    - Multiplier – electric meters can only measure a limited load. If a facility has a high voltage or demand need a meter with a multiplier is normally installed. To find the actual usage the meter reading must be multiplied by the multiplier listed on the meter.

    - PA Gross Receipts Tax – this is a state tax levied on the power company that is passed on to the consumer.

    - State Sales Tax – this is the 6% sales tax charged by the Pennsylvania Department of Revenue. If your facility is tax exempt, this charge should not appear on your bill. If it does, contact your power company and file a tax exempt form. You may also be entitled to a refund from the state. Contact the Pennsylvania Department of Revenue to see if you qualify.

Rate Schedule or Tariff

Each power company has its own rate schedule or tariff. The two names are interchangeable. These documents describe how the power company determines each of the charges on the electric bill.

The tariff or rate schedule also shows any incentives for conserving energy or ways to reduce the charges on your account. These may include discounts for outside lighting, heating and off peak usage.

Tips to Save Energy

- **Aeration** – Providing air for aeration is among the most expensive processes at a sewage treatment plant. Mechanical aerators are typically the most expensive while fine bubble diffusers are the least expensive to operate. Significant savings in energy cost can also be achieved by insuring that tanks are not over aerated.

  If a certain amount of air is divided into large bubbles, while an equal amount of air is divided into small bubbles, the smaller bubbles will enable a greater transfer ratio of oxygen into the water. This is so due to the fact that the smaller bubbles will contain the same volume of air in a greater number of air bubbles. As the number of bubbles increase, so does the available surface area over which air can be transferred into water. Fine bubbles are much more efficient at transferring air because they create a larger transfer surface area per unit volume of added air. While coarse bubble diffusion efficiency may have an oxygen transfer efficiency (OTE) of 0.75% per foot of depth, fine bubble systems may have an OTE of up to 2% per foot. This means that twice as much air can be transferred from the same air volume using fine bubbles as could occur using coarse bubbles.

- **Motors** – Energy efficient motors are normally constructed with the highest quality material and more copper in the windings. Because of the high quality material and workmanship, energy efficient motors run cooler and last longer than standard efficiency motors. Energy efficient motors are an average of 3% more efficient. This can vary by 1 or 2 % depending on the manufacture and motor size. Energy efficient motors can also reduce power factor. When all the benefits of high energy efficient motors are considered they can quickly pay for themselves.

- **Lighting** – Energy efficient lamps are available. These lamps produce the same amount of light while requiring about 20% less energy. Low heat ballast are also produced that require significantly less electrical energy. Magnetic core and coil ballast require less energy than electronic ballast and they produce more light. By upgrading facility lighting a savings of approximately 25% in electric charges for lighting can be realized.

- **Scheduling** – Often there are several pieces of equipment that only run a few hours each day. The demand charge can be reduced by scheduling the equipment to run at different times (see discussion above on demand charge). The demand charge is a large portion of the electric bill and is usually the easiest to reduce. The demand charge is easiest to reduce because it generally only requires scheduling changes and no equipment costs or changes. For a quick calculation it can be assumed that one-kilowatt of demand is charged for each horsepower used.

- **Flow** – Most sewage treatment plants have at least one pump station. These pump stations pump raw sewage to the headworks of the treatment facility. By adjusting the pump controls the flow to the plant can be equalized. The pumps should be adjusted so that they pump as close to the average flow rate as often as possible. This will reduce the demand charge at the pump station. There are also benefits in the treatment process as well.

- **Pumps** – Pumps should be well maintained. Items like worn bearings and improper packing can cause the pump to operate at low efficiency. The operating temperature of these items should be monitored. Corrective action should be done when the temperature rises above normal. The impeller, casing and wear rings should be inspected regularly and replaced as needed.