Energy Conservation in the Solvent Extraction Area[1]

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ABSTRACT

Both old and new ways to conserve energy are discussed. The old ideas are basic fundamentals and will save 14% – the 1980 goal. Some present methods can be incorporated for additional savings. Thought must be given now to long range plans for energy savings in the future. Today, energy savings can and must be made by running the plandt as it now exists to its maximum efficiency. Suggestions in this paper should be reviewed and applied to your plant. Last of all, think energy conservation twenty-four hous a day – you wil then meet the Federal Energy Administration target of saving 14% energy in 1978 and not in 1980.

The Federal Energy Administration has targeted plants processing oilseeds to reduce overall energy consumption 14% by 1980. Specifically, I am going to discuss a 14% reduction of energy in the solvent extraction plant using both old methods and new technology.

The goal to reduce energy consumption by 14% is not a difficult target. In fact, this percentage reduction is the easy step and can be accomplished with a minimum addition of equipment. There are both technology and equipment now available to reduce energy consumption far beyond this amount. However, I want to divide my discussion into two parts, P and T. P stands for the psychological approach, and T represents technical modifications.

The psychological theme is: Do you really want to achieve this goal and are you willing to make the effort to do it? Also, is your management serious about reducing energy and are they willing to support your program?

Historically, America has been spoiled by luxury of cheap energy. As a result, the financial incentive to conserve energy has not been a factor in either design or operation. My first contact with designs to save energy was with oxygen plants designed in Germany that Blaw-Knox built in the United States in 1954. These plants used large interchangers to recover every available BTU in the plant. This was done at increased capital investment which we would not employ in the United States because the payout for the equipment would not be offset by the savings in energy.

The extraction plants we designed in the United States for Japan beginning in 1962 had to be based on low energy consumption since energy costs in Japan exceeded ours many times. For example, we need vacuum pumps rather than steam jet ejectors because electricity was cheaper than steam even though the ejector is mechanically more reliable than a motor-driven vacuum pump.

We sold a large soybean extraction plant in Germany in 1971, since our utility consumption per ton of soybeans processed was greatly lower than that for plants designed in Germany. The president of this German company stated that energy was a vital economic factor in a soybean processing plant, and he predicted that in a few years the United States would face the same problem. He also stated we would change our methods of design and operation. Well, this time has arrived, and we are not only faced with greatly increased energy costs but also with the limited availability of energy to keep our plants running.

The psychological theme that confronts us is: Are you really thinking energy conservation in your personal life and are you making an effort to reduce this consumption? I would like to ask the following questions:

1. Do you keep records and compare monthly and yearly consumptions and costs for:
   a. electricity,
   b. natural gas or fuel oil,
   c. water?

I personally do this and have for the past five years. By doing so, I have been able to reduce consumption and costs by taking conservation measures.

2. Do you keep a record of your automobile gasoline consumption and check the miles per gallon obtained? If you suddenly find a change for the worse, you are warned that something is wrong and you must have your engine tuned to correct the problem.

If you are practicing these steps, you are now thinking conservation, you believe there is an energy shortage, and this thinking will carry over to your conservation in the plant operation.

If you are thinking energy conservation, let us discuss the T or technical aspects, and first some basic old ways to reduce plant energy consumption. The first step in your program is to prepare a heat and material balance for the plant. From the figures obtained, you can determine the ideal steam, electrical, and cooling water consumption per ton of seed processed that is possible in your plant as it now exists. This is the figure to compare with the actual consumption in the plant.

Most extraction plants do not have ample steam meters installed in their plants nor are they checked for calibration on a regular basis. Recording steam meters must be installed in the following locations to measure steam consumed:

1. The boiler plant
2. The preparation building
3. The extraction building
4. Sparge steam to the desolventizer toaster unit
5. The refinery

Each day the plant superintendent must inventory the steam consumed from the previous day to determine if consumption has increased, take steps to locate the reason, and then institute corrective action. The investment for these meters is essential as a starting point to eliminate needless steam waste.

Before installing new steam conservation equipment, there are many basic changes that can be made to reduce steam consumption in the plant:

1. Replace all steam traps with inverted bucket traps. These traps are the most reliable and will insure that steam is not being bypassed.
2. Check all steam relief valves for leaks and repair if required. Provide a regular maintenance program for relief valves.
3. Check for steam leaks in the plant and correct these obvious wastes.

[1]Presented at the AOCS Meeting, St. Louis, May 1978.

TABLE I

Plant capacity T/D soybeans 150 psig to turbine 20 psig from turbine at 35% efficiency	Electric motor replaced by turbine (hp)	Steam required for turbine (lb/hr)	Sparge steam required for D-T @9lb/hr/T/D
1100	100	6250	9900
1600	150	9400	14400
2500	250	14000	22500

4. Check for torn and damaged insulation. Survey the plant to see if there is adequate insulation for all equipment and pipes.
5. Closely check and control the amount of sparge steam used in the desolventizer toaster. Most extraction plants waste more steam in the sparge to this unit than at any other point by at least 33%. Install a recording temperature indicator in the dome of the D-T unit and control this temperature between 155 to 170 F. If the temperature is over 170 F, then you are using too much steam.
6. Control the boiler operation to achieve maximum efficiency.
7. Install condensate return units in both the preparation and extraction areas so that as much hot steam condensate is returned to the boiler as possible. This saves energy by not reheating cold feed water makeup for steam production.
8. Increase the miscella concentration from the extractor to the maximum. For soybeans, this concentration should be at least 30%. There are many plants operating with a miscella concentration of 20% or lower.

These eight points are old ways for reducing steam consumption and do not entail a large investment. I am certain if they are followed, you will reduce consumption by over 14%. There will be an effort on your part to keep good records, correct problems when energy consumption increases, and to institute a good maintenance program.

Now I would like to discuss some designs that are already in use in many plants but will require a large capital investment:

1. Install a dual stage evaporation system. When steam costs only $.50/1000 pounds, a plant operating at under 500 tons per day of soybeans could not justify this expenditure. Today, plants operating at a capacity of 100 tons per day should use this system.
2. Install heat-contacting equipment to mix all condensed solvent with all excess sparge steam in the plant. This system is not complex nor expensive and captures all excess BTUs into heating solvent to 130 F.
3. Use hot solvent vapors from the second stage evaporator in a liquid-vapor eductor to heat the solvent entering the extractor. This eliminates the need for a steam-heated solvent heater.
4. Install a predesolventizer between the extractor and the D-T unit. This is a new development and is one that may not be familiar. Dravo Corporation has two of these units in operation, one since 1964. Approximately one-half of the solvent is removed in the predesolventizer using superheated hexane vapor. This method results in less sparge steam being used in the D-T unit, and a lower moisture content in the flakes on the sparging tray. There is enough heating surface in the heating trays of the D-T to reduce the flake moisture so that the exit moisture from the D-T is 14%. The need for the meal dryer is then eliminated. The steam consumption in the predesolventizer, D-T, meal cooler system for soybeans is 30% less than that of the conventional D-T, meal dryer, meal cooler system. This is the system that will be employed in today's new modern plants and is a major steam saver.
5. For cottonseed plants, a vapor desolventizer-deodorizer system can be used to replace the conventional D-T unit and meal dryer. This installation will reduce steam consumption by 27 to 33%. The moisture content of the cottonseed cake from the vapor desolventizer-deodorizer system is 9 to 10% compared to the conventional D-T, dryer system which yields a moisture content of 10 to 11%.

While conservation of steam is the major factor in energy savings, electricity consumption can also be reduced. Many plants operate equipment using oversized motors which is a waste of energy. How many of you are using a 10 horsepower motor when a 5 or 7½ horsepower motor would suffice? A program should be started to list all motors in the plant and then use a wattmeter to check which motors are grossly oversized. These should be replaced with properly sized motors to improve the overall power factor of the plant.

Many of you are operating plants with undersized extractors. An energy saving scheme would be to install an oversized extractor and then operate with thicker soybean flakes. Use 16 to 18 mil thick flakes rather than 10 to 12 mil flakes and eliminate the operation of one or more flaking mills. This will save operating a 50 to 75 horsepower motor on the flaking mill and allow the extractor, which uses little power in its operation to do the extra work. An added bonus that will result in using an oversized extractor is a steam savings in the D-T operation. A larger extractor will provide a longer drain time permitting more solvent to drain from the flakes and thus reducing the steam used in the D-T unit.

A novel energy scheme that Dravo has developed and on which it has a patent pending is to use a steam turbine to drive the D-T and then take the extract steam from the turbine and use it as sparge steam in the D-T. This utilization of energy has a new work, cogeneration, which President Carter used recently in his energy speech. The turbine driving the D-T would utilize 150 psig steam, and the extract steam from the turbine discharges at 20 psig for use as sparge steam. The D-T unit requires the largest motor in the extraction area and also is the largest consumer of steam. The turbine drive has an efficiency of 35%, and the steam required to operate the turbine is less than that required for sparge steam in the D-T. Some examples of motor sizes taht would be replaced for various plant capacities are given in Table I.

I am sure future plants will use cogeneration to its fullest extent. These plants will generate steam at very high pressures, drive turbines to generate all the electricity required for the plant, and then use the extract steam from the turbine for process requirements. ●