Quality Control in Oil Processing

SUSUMU SATO, Nissin Oil Mills Ltd., 1 Shin Mori Machi, Isago-Ku, Yokohama, 235, Japan

ABSTRACT

The Nissin Oil Mills have installed computer controls on the entire oil processing line to improve plant efficiency and to produce products of uniform high quality.

The main work of our company is to produce oils for cooking, salad dressing and so on from raw materials imported from many countries. We use such oils as soybean, rapeseed, sunflower, cottonseed, corn, sesame, linseed and coconut. Therefore, we have many problems to be solved all the time. Since oils are extracted from raw materials and refined to make products, we have the facilities in our plant for oil extraction and refining on the same line, that is, crushing and refining proceed continuously. The oil extraction process is controlled to produce a crude oil that is easily refined. In Japan, a number of oil producers use such complete systems, but in other countries oil extraction is still done separately from its refining and processing. In the Japanese market, consumers demand quality, especially in the flavor of edible oils, and Japan is one of the countries in the world where consumers are requesting the highest level of quality products from producers. Therefore, good quality control is very important.

The first problem in the refining process is possible contamination caused by mixing of oils. In Malaysia, palm oil is processed in many plants into RBD palm oil, RBD palm olein, RB palm stearin and so on, with the simple palm oil as the raw material resulting in a number of products. Thus, with many kinds of oil, many more products are to be produced.

Every commercial product has its own standard, not to be mixed together even with the same variety of oil. For example, when palm olein is mixed with palm stearin, it moves out of the standard, losing its value as a commercial product. Furthermore, mixing different kinds of oil results in quite different characteristics, which causes great problems upon using, such as changes of iodine values, solid fat or liquid fat, and so on. Now, how can such mixing be avoided?

In oil processing, generally deacidification, decolorization, deodorization and, for some oils, even dewaxing or fractionation are needed. In modern refining facilities, the operation is conducted continuously and automatically. However, the time needed for every step of processing is not short. In other words, a fairly large amount of oil remains in the processing equipment, making it possible to mix one oil with another when the equipment is used for a different oil. This can be avoided only if oil remaining after processing is completely eliminated. How efficiently the first oil is replaced with the new material is the key to success in efficient production that maintains high quality.

The next question is how to obtain uniform quality. Raw materials of oils and fats are natural products, the quality of which vary by climate, district, transportation, storage conditions and so on. Strictly speaking, the quality of the final products is very much influenced by these factors. Naturally it causes fluctuation of the quality in the final products if such different oils are processed under the same conditions. To control the process and have the final products of a uniform quality is feasible with a high level production technique which is the starting point of quality control.

Another question of importance is how to proceed with production under the same conditions all the time using the same raw material. It sounds simple, but actually is very difficult. Under the same conditions the same quality is not always produced because of a minor change not found by the operator, or variable external factors.

It is important to solve these two questions of mixing of one oil with another while changing materials, and of carefully controlling the production facilities.

Recently electronics have made amazing progress, but this field is applied to very limited fields, namely, to academic calculations, mechanical processing and so on, and is rarely used to control the processing in the plant. One of the reasons why it is not applied to plant processing is that a plant is operated in very different functions, and the system to control them is not uniform. Accordingly, introduction of the computer controlled system requires a very large investment without any promise of a satisfactory conclusion.

With new developments in electronics and the need for

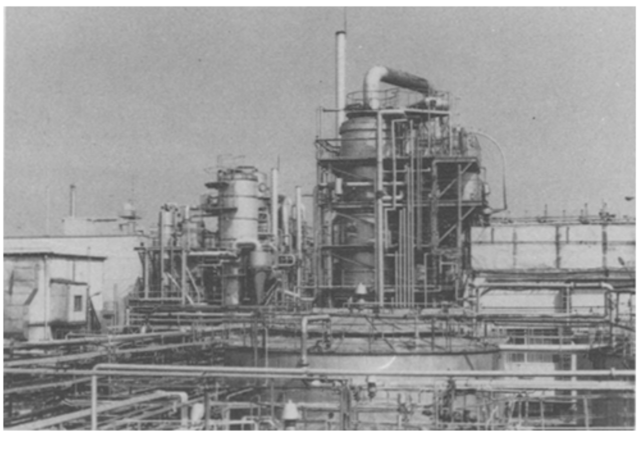

FIG. 1. Computer-controlled refining plant.

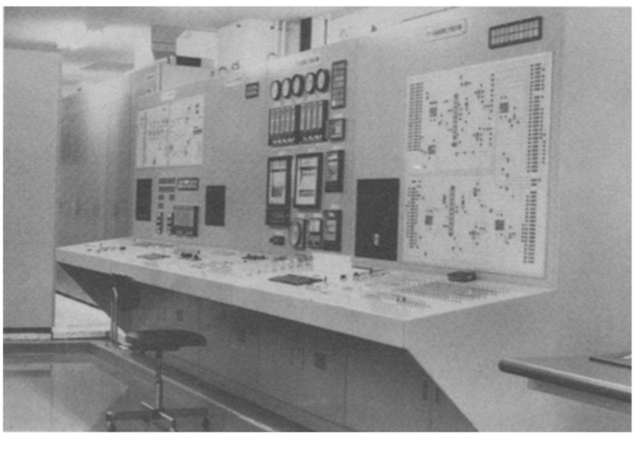

FIG. 2. Control room.

better controls in the plants, we decided that computer controlling is a must for the purpose of obtaining the stable quality we need. The best way to get improved quality is to combine all the possibilities for better process control. Those advantages include reducing the amount of utilities such as steam, electricity, water and so on in variable expenses, as well as labor saving by reduction of manpower. We have 5 series of large scale facilities, which are operated continuously for 24 hr in three shifts. Since installing this electronic controlling system using operation know-how accumulated from long experience, all processing equipment has been controlled by this system through instruments, various sensors, controllers and so on. All an operator now has to do is watch the controlled status mainly by patrolling. Thus, switching the oil variety can be accomplished in the best operation procedure without loss. For example, even when the operators change shifts, fluctuation of the operation can be avoided completely. Furthermore, as another excellent characteristic of this system, accumulated data in the past several hours can be confirmed visually as a graph on the display for review whenever any question arises in the process. When something abnormal has happened, the source of trouble can be traced easily. This contributes greatly to the uniform quality of the products. Conventional automatic facilities are very useful in producing uniform quality products. However, they are not good enough when a change of operational conditions is required by automatically interlocking to other controllers organically due to different oil qualities or other external factors. These defects can be covered adequately by the computer controlling system. Operational conditions will have to be changed in various ways for production of a uniform quality from variable raw materials, and if such change is made erroneously, the quality of the final products fluctuates as a result.

These changes in our plants required approximately 5 years to implement, and most difficulties have been overcome by the efforts of the technical operators, who are the operators, and at the same time the electronic technicians and technical analysts. The highest level of production quality is obtained by their prompt action and their wide knowledge in processing, electronics and technical analysis.

Energy Considerations

GUNNAR HARALDSSON, Alfa-Laval AB, Food & Dairy Engineering AB

ABSTRACT

A general survey is given on possibilities for energy conservation in an oil refinery with special consideration given to palm oils and coconut oil. Some selected areas are discussed more in detail: heat conservation by means of regenerative heat exchangers, optimization of vacuum equipment for deodorization etc. and use of heat pumps. Some examples are given to illustrate possible savings and payback time for installation of energy saving equipment.

INTRODUCTION

The rising energy costs experienced throughout the world over the last 10-15 years have made energy the major single processing cost for a number of refiners. In some cases investments in energy-saving equipment can have payback times calculated in months or even weeks.

However, there is no single set of measures that can be taken, as these will vary from country to country and even from plant to plant. What can be done is to give broad outlines of measures that can be applied within the oil refining industry, although these will have to be related to specific situations.

SOME THEORETICAL VIEWS ON ENERGY TRANSFORMATIONS

It is well known that according to the first law of thermodynamics energy can be transformed from one form into another, but it cannot be created or destroyed. It is therefore somewhat contradictory to talk about energy savings. By using the concepts of enthalpy, free energy, entropy, etc. it is possible to get quantitative measures of energy transformation and quality of different kinds of energy, but in practice it is not so easy to use this for engineering calculations. An easier way to understand what happens when energy transformation and transportation occurs is to utilize the concept of exergy and anergy, which was introduced about 20 years ago. This alternative to conventional thermodynamics has been further developed by Kaiser, Grassmann and others (1,2).

According to this theory all kinds of energy can be considered as being composed of two complementary parts, which are called exergy and anergy. Exergy is the fraction which can be used for work while the other part, the anergy, is of inferior quality and of little interest in engineering except in special cases (e.g., for heat pumps). In all processes energy is not consumed, but exergy is to a larger and smaller extent transformed into anergy, and it is desirable to minimize this transformation as far as possible.

COSTS OF DIFFERENT KINDS OF ENERGY

Only two kinds of energy are considered here – heat energy (in the form of steam) and electrical energy. Electrical energy is one of the more noble forms of energy (high exergy and low anergy) and is also often (but not always) more expensive than heat energy. The cost of electrical power in some European countries is shown in Figure 1. The big difference in costs is due to the method of production. In Norway practically all electricity comes from hydroelectric power stations, in Sweden, from hydroelectric and nuclear plants, and in Germany and Holland mainly from plants powered by fossil fuels such as coal, oil or gas.

In most cases steam is produced in boilers fueled either by fossil fuels or by locally available fuels such as sunflower husks or waste from palm-oil mills. The relative cost of steam compared to electrical energy is of great interest when designing a system to optimize plant energy costs.

Figure 2 shows this relationship for a number of countries and clearly demonstrates that the optimal solution will vary from land to land. It will even vary from area to area as shown by the two figures from India, one based on steam generated from oil and the other on steam from coal. Such considerations now determine whether vacuum should be raised by steam ejectors or vacuum pumps.