

THE PRO-XAN PROCESS A METHOD TO REDUCE ENERGY FOR ALFALFA PROCESSING

George O. Kohler, and Richard H. Edwards

Western Regional Research Center, U. S. Department of Agriculture
Science & Education Administration, Berkeley, California 94710

The dehydration industry in the United States produces about 1.5 million tons of dehydrated alfalfa and grass annually. During the past ten years the industry has been undergoing changes from pressures which have threatened its very existence. These include increasing pressure to invest no-return capital to reduce air pollution, increasing fuel costs, and increasing transportation costs. Continued increases in fuel costs have caused the industry to adopt practices that possibly may decrease the overall quality of dehydrated alfalfa. The Midwest, which is the hub of alfalfa production in the U.S., is also climatically suited to allow windrowing and partial sun-curing prior to dehydration as a means of energy conservation. This practice may cause a wide variance in both physical appearance and nutritional quality. When partial sun-curing in the field is practiced, product losses of 15%-25% may occur. This loss is primarily from the leaf fraction, the portion of the plant with the highest nutritional value. The above practices are causing a shift of dehy usage from historical markets to a usage dominated by ruminant animals. Furthermore, since whole alfalfa is relatively high in fiber and low in energy, it tends to be rejected in computer-formulated high energy rations for poultry.

During the past decade a great deal of research has been done to develop new systems of forage processing which solve these problems in an efficient manner. Based on continuing economic analysis, laboratory and pilot plant research, the USDA has developed a system by which existing dehydration plants can be converted to a new process, the Pro-Xan Process. This process requires less energy and produces less pollution than conventional dehydration. It produces an extra high value, high energy product for poultry and pig rations, thus reducing freight costs per unit of nutrients. It produces a dehydrated forage with increased fiber digestibility for ruminants. This product compares favorably in physical and nutritional characteristics to the products that the industry will produce as it adjusts to increasing energy costs.

A greatly simplified diagram of the process is shown in Figure 1 (Slide 1). The fresh alfalfa is ground and pressed. The green press juice is heated to coagulate the protein contained therein, which is then separated and dried to yield the high energy, high protein, high pigment product desired for supplementing broiler and layer rations. The residual brown juice (also called "whey" or "solubles") from the protein separation is added to the press cake after concentration and the mixture is dried in a conventional forage dehydrator.

An early commercial LPC plant using brown juice recycled to the press was operated by Batley Enterprises at Brawley, California, from 1968-1972. Its closing was related to the loss of dehydrated alfalfa export markets. The yield of LPC at the Brawley plant was 3-5% as compared with 15-20% obtained by the newer Pro-Xan process. Another commercial plant owned by France Luzerne, Paris, France, has been successfully extracting leaf protein from alfalfa since 1976 using a waste heat evaporator for concentration of solubles. These are commercial and semi-commercial plants operating or under construction in Hungary, the United Kingdom, and Denmark, but no detailed information on the size or effectiveness of the operations have been publicly released.

Figure 2 (Slide 2) shows in more detail the current USDA developed system. The process was made more economically sound by increasing the LPC yields and by reducing energy requirements. The process also results in a simultaneous reduction in air pollution from the dehydrator. This is the system which is being installed at Valley Dehydrating Company (VDC), Sterling, Colorado.

Cool brown juice (or water) is added to the chopped alfalfa as it enters the grinders. The ground wet mass passes through a single screw press. The press cake is mixed with more cooled brown juice and then repressed in the second press of the tandem pressing systems. The press cake from this press is mixed with concentrated brown juice from a later step of the process and then dehydrated in a rotary dehydrator equipped with a stack gas recycle

system. The green juices from the presses are combined and heated to 85-90°C by indirect steam and direct steam injection methods. The coagulated protein is separated from the brown juice in a decanter-type continuous centrifuge. The protein fraction, containing 50-60% moisture, is carefully dried in a rotary dehydrator to about 10% moisture. Portions of the brown juice are recycled to the grinder and the second press fed as indicated above, but eventually all of it is concentrated to a 50% solids syrup using a waste heat vacuum evaporator. The evaporator operates on energy supplied by the stack gases of the press cake dehydrator.

A normal dehydrator requires approximately 1600 BTU's to evaporate one pound of water. We expect the dehydrator-waste heat evaporator system to require approximately 650 BTU to evaporate a pound of water. For the entire plant, the energy savings (fuel and electricity) are calculated to be 38% less than a normal dehydration plant with the same tonnage output.

Valley Dehydrating Company made the decision to modify their existing dehydrating plant to the Pro-Xan process in 1978. Due to many many unanticipated problems, production did not commence until October 5, 1978, a few days before the end of the production season. The early part of the 1979 production season saw only sporadic LPC production as the materials handling equipment was beefed up to accomodate the increased throughput, and personnel learned to operate the new equipment and control systems. The plant operated continuously on the Pro-Xan System for the last two months of the season. This operation has shown that the engineering scale up from pilot plant to commercial plant was accurate. We projected Pro-Xan yields in the area of 15%. Actual Pro-Xan yields exceeded 15%. VDC actually extracted the equivalent of 2000 pounds of Pro-Xan per acre-year. This amounts to 1140 pounds of crude protein per acre, or almost twice the yield of protein obtained from soybeans (663 lb/acre).

The limited production of Pro-Xan has enabled VDC to supply eight major broiler producers in the U.S. with adequate Pro-Xan tonnage for commercial sized feeding trials

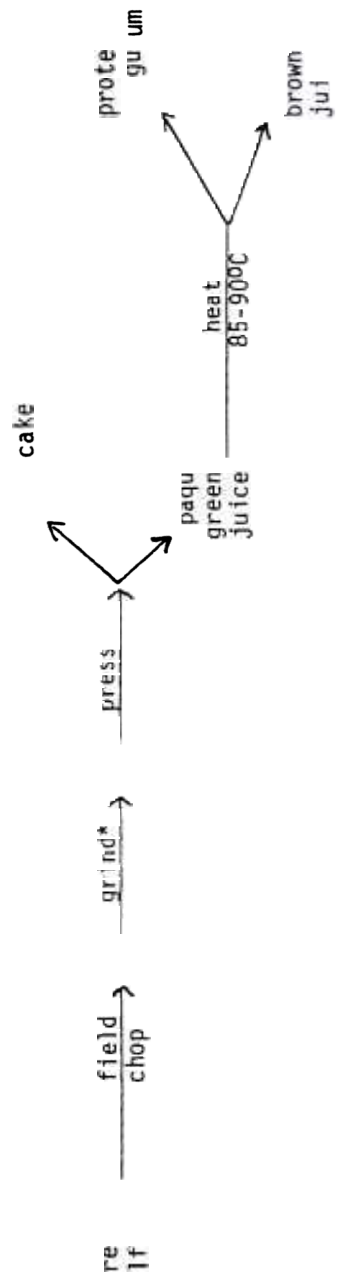
While the USDA developed the process through the pilot plant stage at its Western Regional Research Center (WRRRC) in California, the VDC plant is essentially a private development supported only by a small grant from the Department of Energy (DOE) and by the advice and cooperation of the USDA scientists and engineers. With partial financial support from DOE, WRRRC assists in debugging the operations and will run material and energy balances on the Sterling plant over a two-year period. This will clearly demonstrate to the U.S. dehydration industry the energy conserving and economic benefits of the process. Energy savings should be about 38% compared to normal dehydration of an equivalent amount of alfalfa. The process will allow much greater utilization of the alfalfa, by allowing the individual components of alfalfa to be consumed by those benefitting the most from a given fraction of alfalfa (or any green leafy plant). Thus, the highly fibrous product is consumed by ruminants, while the high-protein, high energy fraction is utilized by poultry. Research has shown that the digestibility of the fiber in the press cake is higher than that of the alfalfa from which it was made. The cell structure is opened up during grinding and pressing resulting in increased availability to rumen organisms. Because of this and the high value given to the Pro-Xan by computer simulation studies, the Pro-Xan process is expected to be highly profitable. This project will demonstrate that suitable markets and adequate selling prices can be obtained for all products.

In cooperation of with USDA and DOE, VDC will communicate all of the problems and benefits of this process to the U.S. dehydrating industry. It is anticipated that most of the technical and economic questions will be resolved such that many other dehydrators could adopt the Pro-Xan process by 1981 or 1982.

In May, VDC will commence Pro-Xan production for the 1980 season. The plant, with all equipment installed and operational, will be processing 30 tons of fresh alfalfa per hour. It is anticipated that production will total approximately 2800 tons of Pro-Xan and 13,000 tons of dehydrated press cake for the season. A year from now, we hope to have some exciting results regarding actual measured yields and energy savings, marketability and value of the products, and process economics.

In closing this discussion, I should like to take a look into the future. A great deal has been said about the increasing need for food for an ever-expanding population. One way to increase low cost food supplies is to increase direct usage of plant products

and bypass animals. Great progress has been made in the technology of the soybean. Soy products are now being sold as meat extenders and substitutes, milk replacers, in beverages, etc. We have already made good progress toward a second generation alfalfa fractionation process (Pro-Xan II process) which will yield a food grade white soluble protein product in addition to a green feed grade product. Development of such food products is dependent on the prior successful commercial development of the basic Pro-Xan process as it is being carried out under the present project.



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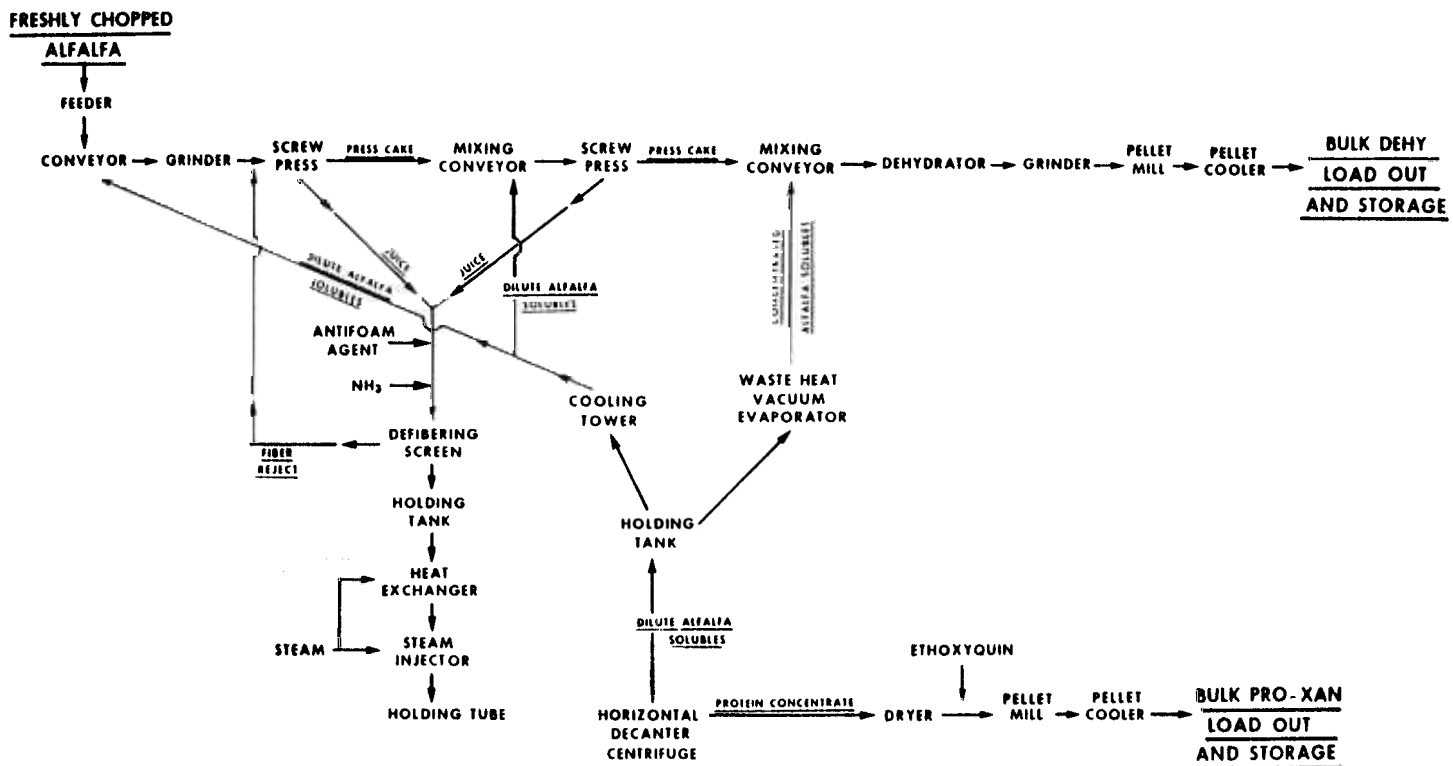


Figure 2. Production of Pro-Xan from Alfalfa.