

Innovative Uses of Biosolids and Animal Manure
A Case Study
Crystal Peak Technology

Patented Crystal Peak Technology offers unparalleled environmental and economic benefits for the treatment and processing of animal manure. The Technology addresses concerns expressed by major environmental organizations and provides a return on capital while complying with new EPA regulations for CAFOs. The key points of the Crystal Peak Technology are:

- Eliminates traditional anaerobic lagoons
- Produces fuel needed to dry fertilizer product
- Captures all nutrients in swine waste to increase the value of the final product and eliminates land application of wastes
- Produces a value added commercially viable natural fertilizer with wide application

In July of 1999, State of Missouri entered into a judicially approved Consent Judgment with Premium Standard Farms (PSF) and ContiGroup Companies (CGC) where PSF & CGC agreed to research, develop and implement Next Generation Technology at their Concentrated Animal Feeding Operations (CAFOs) in Missouri after obtaining approval from the three member management advisory team (Expert Panel) designated pursuant to the State Consent Judgment. As stated in the Consent Judgment: “This technology may become the basis for setting improving performance standards for the industry.” Premium Standard Farms® evaluated a number of existing and emerging technologies to identify a preferred technology.

Premium Standard Farms® identified the Crystal Peak Technology as the preferred technology to comply with the Consent Judgment. Crystal Peak Farms, the Inventor Company for the Crystal Peak Technology, was hired by Premium Standard Farms® to advance the technology through a pilot program using full size equipment rather than laboratory size equipment. The pilot program was operated for four years producing a number of value added products with NPK values in the range of 10-10-10 to 12-12-12.

The Crystal Peak product is an odor free, pathogen free product and heavy metals well below EPA and state regulatory limits. The product has secondary nutrients of sulfur, carbon, calcium, iron and magnesium and micronutrients of manganese, copper and zinc.

The Crystal Peak Process consists of separate and distinct process steps that when integrated produce a value added product. The process steps are:

- Internal Recirculation Process (IRP)
- Anaerobic digestion
- Liquids/Solids separation
- Brine and water recovery
- Fertilizer manufacturing
- Energy recovery and pollution control

The Internal Recirculation Process is key to the overall process in that it prepares the manure for further treatment. It eliminates the need for lagoons, a major environmental concern. Each set of barns is equipped with an IRP installation. Each barn is flushed every two hours with solution that has been screened within the IRP. The IRP provides the ability to deliver undiluted waste to anaerobic digestion. Sulfuric acid is added to the IRP to minimize ammonia emissions in the barns.

The IRP product is pumped to a central digestion facility. The digestion process takes 28 days. There are five digesters at the central facility and they are operated on a batch basis. The digesters are operated using waste heat from the fertilizer drying circuit. During the 28 days the volatile organic material is removed from the slurry-like substance and converted to methane gas. The methane is captured and used as a heat source during the fertilizer manufacturing process.

Following digestion the solids are pumped to a settling basin where natural settling process takes place. Bottom solids are pumped to a liquids/solids separation process that consists of a high-speed centrifuge and ancillary handling equipment. Liquids from the settling basin are pumped to a storage pond and held until ambient conditions permit freeze/thaw separation to proceed.

The freeze/thaw separation is key to the high nutrient value of the final product. It captures the high value nutrients that are discarded in traditional treatment of manure.

During the freeze/thaw process the liquid from the settling basin is sprayed vertically within the confines of a lined pond and an ice cone is built. As the feed solution freezes the soluble salts are expelled from the solution because water with a content of soluble salts freezes more slowly and clean water freezes faster. During the thaw cycle the reverse happens. The brine thaws first and upon thawing it is collected in a brine storage pond. As the thaw process proceeds, clean water is produced. The clean water is of the quality that it can be treated and recycled back to the animals. In areas where the climate does not permit freeze/thaw an evaporation process can be employed.

The centrifuge cake is combined with highly concentrated brine from the freeze/thaw process and fed to the fertilizer manufacturing process. Biogas that has been captured from the digestion step is used for the heat required for fertilizer manufacturing. Following the manufacturing and drying process the fertilizer pellets are moved to a charring step for removal of odor and any remaining pathogens. The fertilizer manufacturing equipment has a wet scrubber to capture nitrogen that is re-introduced into the storage pond. The final fertilizer product is screened to the desired size and the fines are captured with a bag house and recycled back to mixing with concentrated brine and centrifuge product.

The final product is homogeneous, odor free, pathogen free and of consistent quality. It can be delivered to the final customer by a transport method of his choosing. The product has the physical characteristics that lend well to blending with other ingredients. It is not dusty and does not break down when conveyed or put through chutes and hoppers.

With a proven process and a product that is the result of environmental stewardship, and that demonstrates the qualities necessary for market acceptance Premium Standard Farms wanted to offer the technology to the market. With Premium Standard Farms being the second largest swine producer in the United States their desire was to concentrate on their core business of raising swine and not marketing a new technology. For this reason they elected to join forces with an organization to accomplish the task of taking the technology to the market.

Premium Standard Farms and Crystal Peak Farms (the technology inventor) formed a Limited Liability Company for the technology. This company is called Crystal Peak Technologies. With the Technology Company in place it was time to find a company for marketing and implementation.

Roberts & Schaefer Company expressed interest to commercialize the technology. An initial proposal was made to Premium Standard Farms and there was interest on proceeding. Roberts & Schaefer Company conducted extensive due diligence on animal waste and animal waste technology. They performed market research and prepared case studies and looked at competing technologies. A determination was made as to the fit of the technology within Roberts & Schaefer Company. The conclusion was that the technology was a good fit with Roberts & Schaefer Company's core business of process engineering and construction. A new company called Crystal Peak Environmental was formed to market the technology. Prior to the formation of Crystal Peak Environmental, Roberts & Schaefer Company was selected, on a competitive basis, to provide engineering and construction for the prototype plant.

Developing and proving a technology that produces a great product with all the characteristics you would want in a natural fertilizer product is only part of the process of having a successful business. The saying that "you can have a technical success but a marketing nightmare" is very true. The product must have the market demand to generate a price to recover capital and to provide an economic return.

Financial models were prepared. Extensive feasibility study work was performed to define the system and sufficient engineering was performed to develop capital costs for the installation. Operating costs were developed and an evaluation of avoided costs was made. With the process proven and a clear understanding of capital costs and operating requirements, a price requirement for the product was established. The next step was to go looking for a marketing partner.

Early in the marketing discussions it was agreed that the strategy was to select a single company to handle the product. The reasoning was to eliminate price competition. Fertilizer companies ranging from small to the largest in the industry were contacted. The small companies had niche markets and the larger companies were in the turf & horticulture markets and general agriculture. It was determined that the larger company was the best route because of their established distribution channels. The larger company would have the ability to supply small companies through their distributors.

J.R. Simplot Company of Boise, Idaho expressed interest in the product very early. With a corporate culture that is very forward looking and with distribution, blending and bagging facilities in place they were the preferred company. They agreed to take the product from the

prototype plant with exclusive rights to market the product in the seven western states and Hawaii. It is expected that this agreement will be expanded to include the entire United States and some international. Prior to executing the agreement J.R. Simplot Company tested the fertilizer product on golf courses in California and Hawaii.

Premium Standard Farms and Roberts & Schaefer Company had reached contract terms for the design build of the prototype plant and with the fertilizer off take contract in place the announcement to build the prototype plant using "Next Generation Technology" was made. It will be located at Premium Standard Farms' Valley View Farm in Sullivan County, Missouri.

The prototype plant will process waste from 107,000 pig places and will produce 8,674 tons per of 11-8-7 granulated. The plant will be the first of its kind in the world and will have a capital cost of \$9,600,000. The first production will be to market for the growing season of 2005.

The Crystal Peak Technology is applicable for waste from poultry and dairy cattle operations. Discussions are being held with dairy cattle operations.