

The Sul Ross Solar Fuel/Food Research Project



Student study group inspect the solar tracker assembly and base unit. The 8 foot hoop will be used as vertical axis bearing way. Note the 12 foot fixture on base unit.

A Member of the Texas State University System

Abstract: This three phase research project is funded by two Sul Ross enhancement grants and is based on performance specifications from the Department of Energy. The objective is to develop a sunlight collection system that processes and transports sunlight for the efficient production of fuel and food with minimal

water use and less cooling/ heating of the growing space.

Project Phase One - Light Capture System: This phase is to design a tracking collection system (top three pictures) which will capture and concentrate sunlight into a beam (or shaft) of light suitable for processing and/or transporting into remote growing environments. Approximately 50% of sunlight's energy is in the visible spectrum, and the other 50% is mostly infrared (heat). In the visible spectrum the blue and red light (but not the green) is used by plants for photosynthesis. The processing unit must use "optics" to separate and direct each spectrum into the growing environment, the production of electricity (or heat), or another use. Certain technology could be used to shift the "less desirable" spectrum back into the photosynthesis range or another approach could be to utilize an algae that has been found to grow in the high end of the infrared.

Project Phase Two - The Growing Environment and Plant Selection: During the design of the growing environment, consideration will focus on minimal water use, local resource recapture, and the development of local processing and use of the products. One concept for the growing environment was derived from the hydroponic system used by Village Farms at Fort Davis, Texas, and another was from the shrimp farms in the Imperial, Texas, area. The Light Capture System should enable the utilization of a more comprehensive system and provide the transfer of sunlight into insulated and sealed growing enclosures which should extend the growing season, minimize water loss, maintain a "designer" growth medium, lower operating costs, and allow the selection of algae or other aquatic plants.

The growth rate of high-lipid algae in sealed enclosures has been documented in recent articles. Valcent labs in El Paso, Texas, has reported that they are growing bio-diesel in a "closed-loop" algae-production system and are showing a yield of 34,000 gallons of bio-diesel (and a like amount of food stock) per year per one acre of area. The production rate makes the selection of algae very attractive, and the growth process requires little water, while the "planting" and harvesting is done with a pumping system. The growth of algae requires a controlled solution of nutrients (called the "Growth Media" in the literature) along with carbon dioxide and light. Major nutrients include carbon, nitrogen, phosphorus, and silicon. The growth process also requires large quantities of carbon dioxide. Both the nutrients and the carbon dioxide can be purchased commercially, but processes to recover them locally are attractive.

Nutrients can be recaptured from liquid sewage, and the process dovetails with efforts to minimize the release of treated effluent into rivers. Carbon dioxide can be recovered from the exhaust of boilers or generators burning conventional fuels or bio-gas which is a product of the anaerobic fermentation or digestion of sewage, livestock waste, or food waste. Bio-gas usually contains about 60 to 70 percent methane and can be burned in conventional boilers or engines.

Project Phase Three - Fuel/Food Processing System & Nutrient Recovery One advantage of the proposed light capture and growth system is that both fuel and food can be produced on land not suitable for normal agriculture. The training of a workforce to grow and process the products can provide local employment.

Project Evolution: This research began at Texas A&M-Commerce with a 2003 grant (bottom left pictures) for fire retardant/solar buildings from the Association of General Contractors. Control/monitoring devices were supplied by Dallas Semiconductor. The program was written in C++ and produced charts that depicted the operation of the pumps and temperatures at ten minute intervals.



Image 3

04/29/2006



Image 4

Primary Researcher: Dr. Keith Klein, Assistant Professor of Industrial Technology at Sul Ross State University, E-Mail: kklein@sulross.edu. Ed.D. Ed Adm. East Texas State, 1987. BS in IE, 1972 (top)

Collaborator: Dr. Martin Terry, Assistant Professor of Biology, E-Mail: mterry@sulross.edu.

A.B., 1971, Harvard University, D.V.M., 1976, Texas A&M University, Ph.D., 1981, Texas A&M University. Specialization: botany, archaeobotany, ethnobotany, phytochemistry.

Collaborator: Kenneth R. Baierlipp, E-Mail: apoenergy@verizon.net. Solar Energy Consultant and supplier of solar PV systems. (apoenergy picture) (bottom)



Image 6



Image 8

