A Case Study Developed
for the
Agricultural Innovation
and Commercialization Center

TAOCO

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This business plan for *TAOCO* is one of the significant results of the four prototype projects addressed through the AICC. And as part of the process, each prototype used the newly developed *INVenture* to analyze their business idea. The purpose of developing the business plans is to provide *INVenture* users as well as facilitators with helpful real-life business plan examples to refer to throughout the business planning process.

Because each of the new ventures are actual business situations that are unfolding in real time, some of the business plan examples that we have placed to date into *INVenture* are more fully developed than others. This is a natural consequence of the development of each new venture.

Access to relevant examples should provide support to the users and facilitators as they undertake the business planning process.

Table of Contents

Executive Summary

Given the partnership with an existing company who is one of the largest aviation deicer suppliers in the U.S., we are confident that this product can be successful. The main issues are regulatory/certification compliance, given the strong positions currently held by existing product manufacturers.

The basic business plan will be mainly in the hands of Company X, since we are primarily technical consultants to them.

Long Term Goals

With this venture I would like to accomplish the following goals:

1.Develop a glycerin-based replacement aviation deicer/anti-icer product to replace current ethylene/propylene products

2. Find a commercially viable market for by-product glycerin from biodiesel fuel production.

3. Support the soybean farmers and producers in the State of Indiana by creating a commercially viable industrial use for soybean oil products.

Business Overview

My product(s) is a glycerin-based aviation deicer/anti-icer to replace ethylene/propylene glycols (EG/PG).

My product will be purchased by airports/airlines, both commercial and military, who are the end users of the product. The typical customer will be airport managers/corporate airlines.

Current practice involves single use of these aviation deicers with direct disposal into waste systems. EG is toxic to mammals, and PG is significantly higher cost than EG. Both costs are related to the rising price of petroleum. The regulations for EG/PG are starting to require recycling/re-use, which involve high costs. Use of glycerin, which is a natural, biodegradable material, would provide both environmental benefits as well as cost savings. Customers will use this product to replace current EG/PG based products.

Product Offering

Patents have been applied for this product and we anticipate that the final formulation will be either patented or a trade secret.

Industry Profile

Industry Analysis

Effective alternative formulations for ADF’s have only recently been discovered so there are only a handful of such fluids past the initial development stage. While the exact formulation of these fluids is proprietary information, the freeze-point depressant (FPD) is usually publicly known.

One promising new formulation is METTS ADF-2, a sorbitol-based Type I fluid developed in 2000. This fluid was approved under SAE AMS 1424C in 2001 and 1424D in 2003. In anti-icing endurance tests performed by an independent facility in 2002, it performed as well as or better than a collection of conventional Type I ADF’s.

The developers claim a BOD5 half that of propylene glycol, and since sorbitol is composed primarily of food-grade materials, aquatic toxicity is not a concern. Sorbitol is a poor solvent and has a higher viscosity and freezing point than glycerin, propylene glycol, and ethylene glycol. Thus, to ensure good performance, many additives need to go into a sorbitol-based deicer and more fluid per plane may need to be used. The fluid costs about the same as propylene glycol-based deicers, so the only advantage to this fluid over propylene glycols seems to be the BOD5 reduction.

Foster Miller, Inc. has also developed a triethylene glycol-glycerol blend Type I deicer. This fluid has a BOD5 that is 85% lower than propylene glycol-based fluids. It also contains only non-toxic additives, so its aquatic toxicity level is also low. The cost is approximately 15% less than propylene glycol-based fluids, but greater savings could be realized if the BOD5 is low enough that runoff does not have to be treated. This fluid has not yet been SAE certified.

The economy in the industry in which I'll compete is somewhat depressed. The aviation industry in the U.S. is under strong economic pressures to cut costs, primarily due to rising fuel costs. This means a lower cost aviation deicer would be very welcome, provided it can meet the performance/regulatory requirements of the industry. Of course, the existing EG/PG industry will strongly resist this change, as it is well-entrenched and has a great deal of input into regulatory standards. The aviation industry is very highly regulated.

With respect to Indiana, this product proposes to provide a significant market for the use of by-product glycein from biodiesel production. Given the proximity of several large major airports (O'Hare, Indianapolis, St. Louis), it might be advantageous for an aviation deicer company to locate in Indiana to produce and sell this product.

Market Potential and Competitor Analysis

Aircraft icing is the accumulation of ice or snow on aircraft during adverse weather (icing) conditions. Favorable conditions for icing include freezing rain, snow, or freezing fog, and are not limited to temperatures below the freezing point of water. Ice accumulation on wings has been shown to occur in temperatures above freezing when rain impinges on wings carrying fuel at sub-zero temperatures. Ice accretion changes the shape and roughness of a wing's surface, affecting flow over the wing. Ice also collects in external electronics and on control surfaces, changing the control properties of the aircraft. Finally, ice dislodged in flight may damage an aircraft’s skin and external instrumentation and may even severely disable or destroy the engine if ingested.

In the period leading up to the 1990's, numerous accidents have been attributed to the accretion of ice or snow on aircraft wings, tailplane, and other control surfaces. In January of 1982 an Air Florida B737 attempted to take off from Washington National Airport, Washington D. C., during a snowstorm. Ice accumulation on the engine pressure ratio probe led to inadequate thrust settings for climb out. Ice on the wings also added drag and lowered the maximum lift coefficient. The margin to stall was reduced, and the airplane crashed shortly after takeoff into the 14th Street Bridge over the Potomac River.

Although fluid deicing had been used since the 1930's and regulations on wing contamination had been in place since the 1950's, no widely followed policy for deicing methods was in use. It was clear that a set of regulations and standards for flight in icing conditions needed to be established. After the B737 crash, the Association of European Airlines (AEA) established a task force activity to define standards for fluids materials specification, procedures for maintenance and cockpit crews, and fluids vehicles requirements during icing operations.

This was the first effort do develop a standardized procedure for the production and application of deicing and anti-icing fluids. Its effects were evident in Europe because no accident in which de/anti-icing was a contributing factor was recorded on jet transport category aircraft for at least ten years since its induction.

Since then, a number of other agencies have created safety standards for the use of deicing and anti-icing fluids. The use of freeze-point depressant (FPD) fluids has remained the most common method for both deicing and anti-icing. This may be because fluid deicing can be performed at the gate, eliminating the need for a centralized deicing facility and minimizing time before takeoff.

More than 35 million gallons of glycol-based de/anti-icer fluids are consumed in the U. S. per year. The amount of fluid used for a single deicing depends on the aircraft, weather conditions, and airport, but on average, it takes 500 to 1000 gallons of fluid to deice a large commuter airplane. The volume needed may even be as high as 4000 gallons per plane in icing conditions. Some of the largest airports in the U.S., such as Chicago's O'Hare Airport can use well over 1,000,000 gallons in a single deicing season at a cost of close to $6 million.

Adverse effects of fluid deicing include the risk for corrosion to aircraft surfaces, although standards are in place to minimize this possibility. In addition, runoff of stormwater from airports that use deicers has been shown to produce detrimental environmental effects on surrounding ecosystems. Most importantly, deicing and anti-icing fluids have themselves been shown to produce adverse aerodynamic effects as waves are produced on the fluids as they flow off a wing. Consequently, several standards were written by the Society of Automotive Engineers (SAE) in the early 1990's to regulate the acceptance of new fluids as de/anti-icers.

Aviation deicer fluids are categorized as either Type I or Type IV. Type I fluids are low viscosity Newtonian fluids. They are used for the removal of frost, ice, or snow from an aircraft rather than to prevent accumulation. Type I fluids are typically sprayed on heated (~ 80oC) and under high pressure. Although they are not specifically designed to do so, Type I fluids may also provide limited anti-icing protection. Type I fluids make up approximately 90% of the de/anti-icer market. Type IV fluids are anti-icers used for the prevention of snow and ice accumulation. The fluids form a thin layer on an aircraft surface that mixes with impinging precipitation to create a mixture with a lower freezing point than ambient conditions. These fluids are shear thinning in that they exhibit different apparent viscosities when subject to differing shear stresses. They have high viscosity in stagnant conditions and low viscosity when subject to increased shear stress. This property allows Type IV fluids to remain on an aircraft to provide protection prior to departure and aids in the expulsion of the fluid when the airplane takes off. Type IV fluids make up approximately 10% of the market.

The majority of spent deicer fluids mix with stormwater runoff and have the potential to enter nearby streams, lakes, and other surrounding ecosystems. The EPA estimates that nearly 21 million gallons of aircraft deicing fluids (ADFs), containing 50% propylene glycol, are discharged to surface waters annually. The remainder are recycled, stored, or evaporated. ADFs have the potential to adversely impact the environment in two ways. First, they may be toxic to humans or aquatic life, and second, they may biodegrade too quickly and deplete the dissolved oxygen in the water. Ethylene glycol was originally the fluid of choice for aviation de/anti-icers. It provides a good freeze-point depression and favorable viscous properties as well as being relatively inexpensive to produce.

However, because ethylene glycol is toxic to humans and aquatic life, the switch has been made to the non-toxic but more expensive propylene glycol. A small amount of ethylene glycol-based ADFs are still used today as a small number of manufacturers still make them and airports try to deplete their stocks of such fluids. Ethylene glycol is classified as a hazardous air pollutant and all stormwater discharges containing greater than 5000 pounds (~ 500 gallons) in a 24-hour period must be reported.

While not considered hazardous, propylene glycol has a similar level of aquatic toxicity to ethylene glycol, both being fairly non-toxic to the environment. However, since ethylene glycol has been shown to be toxic to mammals, more strict regulations on its discharge are enforced. Propylene glycol-based ADFs, while essentially non-toxic to animals and humans, are still harmful to the environment. Fish and other aquatic organisms need dissolved oxygen to live, and ADFs may consume a majority or all of the dissolved oxygen in a body of water as they biodegrade. Waters with no dissolved oxygen may also have a foul odor, dark color, and bad taste.

Airports must also meet all local, state, and federal regulations for wastewater discharge. As part of the Clean Water Act (CWA), any industrial facilities that discharge contaminated stormwater to surface waters must hold a National Pollutant Discharge Elimination System (NPDES) permit. Discharge by facilities with NPDES permits is self-monitored and statistics are collected by the EPA. Regulation is usually established at the state level. In order to comply with regulations and avoid fines of as much as

$25,000/day, millions of dollars are spent by airports on elaborate deicer collection systems.

Original capital investment for the most basic of collection systems, such as a single vacuum truck, can be as low as $100,000. Large airports, however, require more elaborate systems that may cost many times more. For example, Chicago's O'Hare Airport has a system that includes deicing pads with drainage collection facilities, detention ponds, and wastewater storage facilities for a total cost of around $98 million. Yearly operating costs at some facilities are upwards of $1.4 million. It is estimated that the cost to treat one gallon of pure deicer fluid is between $0.90 and $1.20 per gallon, depending on the method used. However, only about half of the costs for treatment are recovered in this manner, so it is not presently cost effective.

The appeal of our glycerin-based product is two-fold. First, glycerin is a natural, biodegradable, non-toxic product, so it will not have the negative environmental impacts that EG/PG products currently have. This may alleviate the need to build costly recycling/reuse systems. Secondly, glycerin is approximately 1/10 to 1/3 the cost of EG/PG, due to its creation as a by-product of biodiesel fuel manufacture. With increasing biodiesel production in the U.S., glycerin is anticipated to readily available and low cost. These are significant advantages for the aviation deicer industry.

Operation and Management Plan

The main issues to be resolved are the formulation of the aviation deicer/antiicer compositions and regulatory certification/compliance. Our work to date has demonstrated feasibility of the use of glycerin to replace EG/PG. However, deicer formulations contain a variety of proprietary compositions incorporating surfactants, anti-corrosion agents, and other ingredients. Therefore, we have partnered with an existing deicer formulation company to develop a glycerin-based formulation, as well as taking advantage of their marketing knowledge.

The product will be produced by Company X (confidential information).
The venture will be located at Company X's facilities.

The product/production will be owned by Company X under appropriate licensing agreements.

Financial Plan

Balance Sheet						
Assets	Startup	Year1	Year2	Year3	Year4	Year5
Current						
Cash		$0	-$4,164,612	-$4,587,969	-$5,053,972	-$5,566,900
Inventory	$0	$0	$0	$0	$0	$0
Non Current						
Startup Costs	$7					
Machinery and Equipment	$0	$0	$0	$0	$0	$0
Buildings and Structures	$0	$0	$0	$0	$0	$0
Land	$0	$0	$0	$0	$0	$0
Trucks and Vehicles	$0	$0	$0	$0	$0	$0
Total Assets	$7	$0	-$4,164,612	-$4,587,969	-$5,053,972	-$5,566,900
Liabilities						
Term/Mortgages	$7	$7	$7	$7	$7	$7
Total Liabilities	$7	$7	$7	$7	$7	$7
Owner's Equity						
Retained earnings		-$3,780,019	-$4,164,612	-$4,587,969	-$5,053,972	-$5,566,900
Contributed Cash Capital	$0					
Contributed in-kind Capital	$0					
Owner's Equity	$0	-$7	-$4,164,619	-$4,587,976	-$5,053,979	-$5,566,907
Total Liabilities + Owner's Equity	$7	$0	-$4,164,612	-$4,587,969	-$5,053,972	-$5,566,900

Income Statement

	Year1	Year2	Year3	Year4	Year5
Income					
Gross sales	$160,000	$167,200	$174,724	$182,587	$190,803
Expenses					
Materials, Labor, Utilities	$5,200,000	$5,720,000	$6,292,000	$6,921,200	$7,613,320
Total Direct Expenses	$5,200,000	$5,720,000	$6,292,000	$6,921,200	$7,613,320
Gross Profit	-$5,040,000	-$5,552,800	-$6,117,276	-$6,738,613	-$7,422,517
General and administrative expenses					
Non-production wages	$2	$2	$2	$2	$2
Occupancy Costs	$0	$0	$0	$0	$0
Taxes and licenses	$10	$10	$10	$10	$10
Transportation/shipping	$3	$3	$3	$3	$3
Advertising	$1	$1	$1	$1	$1
Other Expenses	$0	$0	$0	$0	$0
Office Supplies	$0	$0	$0	$0	$0
Travel	$0	$0	$0	$0	$0
Start-up Costs	$7				
Depreciation	$0	$0	$0	$0	$0
Total G & A Expenses	$23	$16	$16	$16	$16
Earnings before interest and taxes	-$5,040,023	-$5,552,816	-$6,117,292	-$6,738,629	-$7,422,533
Interest Expense	$0	$0	$0	$0	$0
Income Taxes	-$1,260,004	-$1,388,204	-$1,529,323	-$1,684,657	-$1,855,633
Net Profit	-$3,780,019	-$4,164,612	-$4,587,969	-$5,053,972	-$5,566,900

Statement of Cash Flows	Year1	Year2	Year3	Year4	Year5
Initial Cash	$0	$0	$0	$0	$0
Cash From Operations					
Sales Income	$160,000	$167,200	$174,724	$182,587	$190,803
Cash Expenses	$5,200,023	$5,720,016	$6,292,016	$6,921,216	$7,613,336
Net	-$5,040,023	-$5,552,816	-$6,117,292	-$6,738,629	-$7,422,533
Cash from Capital Purchases/Sales					
Capital Investments	$0	$0	$0	$0	$0
Cash from Financing					
New Capital	$7	$0	$0	$0	$0
Principle Payments	$0	$0	$0	$0	$0
Net	$7	$0	$0	$0	$0
Taxes	$1,260,004	$1,388,204	$1,529,323	$1,684,657	$1,855,633
Ending Cash	-$3,780,012	-$4,164,612	-$4,587,969	-$5,053,972	-$5,566,900

Valuation	
Investment Outlay	$7
Discount Rate	0%
Net Cash Income	
Startup Period (year 1)	-$3,780,012
Average yearly cash flow (years 2-5)	-$4,843,363
Value of Business	
Minimum (net assets in business at the end of five years)	-$5,566,907
Projected	-$23,153,472
Internal Rate of Return	

Breakeven Analysis	Year1	Year2	Year3	Year4	Year5
Breakeven Volume (average)	17,500	19,250	21,175	23,292	25,622
1. Total Direct Costs	-$1,259,981	-$1,388,188	-$1,529,307	-$1,684,641	-$1,855,617
2. Per unit revenue (average)	$2.29	$2.17	$2.06	$1.96	$1.86
3. Per unit costs (average)	$74.29	$74.29	$74.29	$74.29	$74.29