Markets for Soy Flour & Bypass Protein Soybean Meal

Prepared for:

Agricultural Utilization Research Institute
Marshall, Minnesota
∞
Liquid Renewable Fuels
∞
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Executive Summary

Background

With the rapid expansion of the biodiesel industry in the United States over the past few years, particularly that segment of the industry that plans to use soybean oil as its primary feedstock (which is most of the industry), the demand for soybean oil soon could outstrip the domestic soybean crushing industry's production capacity.

As of September, 2007, the National Biodiesel Board listed the following biodiesel plants whose primary feedstock is or will be soybean oil:

- 61 operating plants with combined capacity of 707 million gallons/year (MG/Y)
- 28 plants under construction or expansion with combined capacity of 680 MG/Y

All of the plants under construction or expansion should be operating by the end of 2008. The combined capacity of these plants and those that already are operating is 1.387 billion gallons/year. It would require 5.2 million tons of soybean oil to operate all this capacity. This is 50% of annual soybean oil production in USA.

The vast majority of soybean oil produced in USA is currently used for domestic food consumption. Therefore, the production of soybean oil will have to be increased greatly if the demand for both food and energy is to be satisfied.

There is no doubt that USA produces enough soybeans to support an expanded crushing industry. Indeed, about a third of the annual crop of 90 million tons (3 billion bushels) is exported. Presumably if crushing margins are good due to increased demand for oil, domestic crushers will be able to keep the additional volume of soybeans they need in the country.

Expansion of the domestic soybean crushing industry is in fact taking place to meet the increased demand for oil. After no new crush plants being built between 2004 and 2006 (the last two new soybean crush plants built in USA were the CHS plant in Fairmont and the Minnesota Soybean Processors plant in Brewster, both of which began operations in the fall of 2003), several new plant constructions or expansions were begun or announced in 2006.

These will expand domestic soybean crushing capacity by about 21,000 T/day (700,000 bushels/day). This would be an expansion of nearly 13% of an industry with current capacity of 165,000 T/day (5.5 million bushels/day). But even all of this increased crushing capacity won't produce enough additional oil to meet current food demands and increasing biodiesel feedstock demands. All of the new capacity will be capable of producing about 1.4 million tons of soybean oil per year, which is far less than the 5.2 million tons that would be needed by all the biodiesel plants currently operating or under construction or expansion that plan to use soybean oil as their feedstock.

A soybean crushing plant cannot produce oil without also producing meal. The new capacity will produce over 5 million T/year of soybean meal. Finding homes for all this meal won't be easy. And if domestic soybean crush is to be expanded even further in order to meet the demand for soybean oil as a biodiesel feedstock, new markets are going to have to be found for the additional soybean meal that also will be produced.

Consumption of soybean meal worldwide, exclusive of USA, has expanded by 94% since 1996, as rising standards of living in the developing world have resulted in increasing demand for meat, milk and eggs. However, during the same period, soybean meal consumption has expanded by only 27% in USA.

In absolute terms, soybean meal consumption in USA increased from 26.6 million tons in the marketing year that ended September 30, 1996 to 33.7 million tons (projected) in the marketing year that ended September 30, 2007, or an increase of 7.1 million tons over the 11-year period.
In the rest of the world, soybean meal consumption increased from 71.3 million tons in the marketing year that ended September 30, 1996 to 141.4 million tons (projected) in the marketing year that ended September 30, 2007, or an increase of 70.1 million tons over the 11-year period.

Given this situation, a logical place to look in order to dispose of increased production of soybean meal would be the rapidly expanding international market. However, Argentina has become the dominant force in the world soybean meal market, accounting for 47% of soybean meal that entered world trade in 2006, up from 28% in 1996. During the same period, USA's share of world trade in soybean meal has declined from 20% to 15%.

In absolute numbers, USA soybean meal exports increased by 2 million tons between 1996 and 2006. During this same period, soybean meal exports by the rest of the world increased by 23 million tons, with 18 million tons of this coming from Argentina.

The situation in Minnesota is similar to that in USA in general, except more so. The five major soybean crush plants in Minnesota (ADM at Mankato, CHS at Fairmont and Mankato, AGP at Dawson and Minnesota Soybean Processors at Brewster) are capable of crushing about 180 million bushels/year, which is 60% of Minnesota's normal annual soybean crop of about 300 million bushels. So there is no shortage of soybeans to process. But a crush of 180 million bushels produces about 4 million tons of soybean meal, while consumption within the state is about half this amount. So Minnesota processors need to find homes outside of the state for about half the meal they produce. This can be difficult to do, given Minnesota's location and traditionally low protein content of its soybean crop, meaning that meal produced in Minnesota must compete with meal produced in other states that has 1-1.5% higher protein content.

So if the soybean crushing industry in Minnesota is going to expand to meet increasing demand for soybean oil as a biodiesel feedstock, the new plants probably will need to produce something other than conventional soybean meal. This study examines two such alternatives to conventional soybean meal: soy flour and bypass protein soybean meal.

Soy flour

Soy flour is a highly nutritious food ingredient that has been used for many years. There are only three producers of defatted soy flour (DSF) in USA: ADM at Decatur IL; Cargill at Cedar Rapids IA; and CHS at its soybean crush plant in Mankato.

Although soy flour has nutritional benefits, it is used primarily for its functional benefits. When incorporated into bread dough, it enables the bread to retain more moisture during the baking process, thereby increasing yield. Thus, it is a money-maker for the baker. It also extends shelf life by decreasing the rate of staling. When used in doughnuts, soy flour absorbs less oil, which is a relatively expensive ingredient, thus saving costs. The rate of incorporation in bread dough and doughnuts is usually in the range of 2-4%.

With only three producers of DSF, the industry is not "transparent," with producers of DSF being unwilling to disclose production figures or pricing. The price usually is within a range of 100-150% that of wheat flour. No reliable statistics are available for production or consumption of soy flour. However, some information can be gleaned by examining consumption of wheat flour, since the primary use of soy flour is blending it with wheat flour in baking applications.

USA consumes 20 million tons of wheat flour annually. If one industry estimate of soy flour production of 540,000 T/year is correct, and if the export market is 140,000 T/year (which is only a "guesstimate"), that would leave 400,000 T/year for domestic consumption. And if 100,000 T/year of this is texturized soy flour (again a "guesstimate"), that would leave 300,000 T/year for the domestic baking industry.

This is 1.5% of the 20 million T/year of wheat flour that is consumed domestically. This is reasonable, given that blend rates are usually in the 2-4% range, in those cases when soy flour is being used.

However, if the primary "driver" for domestic consumption of soy flour is its use as a complementary ingredient to wheat flour in breads and doughnuts, one cannot get very encouraged about the growth of that segment of the industry. Per capita consumption of wheat flour in USA declined by ten pounds/year (about 7%) between 2000 and 2002, due to the Atkins Diet craze. After slipping a little more from 2002-2004, the decline has leveled off, but a rebound has not yet occurred. Until it does, soy flour lacks the "vehicle" it needs to increase domestic consumption significantly.

On the export side, one of the largest users of soy flour, China, has been increasing its domestic production capacity of edible protein, in tandem with is rapidly increasing soybean crushing capacity.

In summary, soy flour is a very small segment of the soybean crushing industry, domestic consumption is somewhat "capped" by negative growth in recent years in wheat flour consumption, and the export market is small and not likely to expand significantly. So building a soybean crush plant based on producing soy flour rather than soybean meal is not likely to be a successful strategy.

Bypass protein soybean meal

Bypass protein soybean meal (BPSM) is a general term for meal that has been produced in a way that reduces degradation of the protein in the meal in the rumen of a multi-gastric animal, such as a dairy cow. This results in more of the protein "bypassing" the rumen and being converted to milk, resulting in higher milk production per cow.

On June 29 of this year USDA/NASS released its first-ever report entitled "Ethanol Co-Products Used for Livestock Feed." Although the focus of the report was on ethanol co-products, especially distillers grains, corn gluten feed and brewers grains, there also was a table regarding feeding of "additional protein sources." USDA's study found that 22% of dairy cattle operations surveyed use high bypass soy meal (HBPSM) as a protein source. Since Minnesota is the #6 dairy state, there is a considerable amount of HBPSM being consumed in Minnesota. Also, Wisconsin to the east is the #2 dairy state.

However, all the HBPSM consumed in Minnesota and Wisconsin is being produced in Iowa or Nebraska.

West Central Soy (WCS), an expeller plant located in Ralston IA (about 50 miles west of Ames) is the leading producer of HBPSM. It introduced HBPSM in 1984 under the brand name of SoyPLUS®. The plant has been expanded twice since 1992. Current production capacity is estimated to be 250,000 T/year.

Cargill at Des Moines IA produces Soy Pass® HBPSM under contract with Borregaard LignoTech of Rothschild WI, using a process that has been patented by Borregaard LignoTech. Besides marketing Soy Pass® itself, Borregaard LignoTech also has an agreement with Land O' Lakes whereby Land O' Lakes, which is the largest feed company in USA, markets Soy Pass® soybean meal under its own brand name, SurePro®. Since the Cargill plant is a solvent plant that produces mainly conventional soybean meal, it is difficult to know how much HBPSM it produces, but it probably is in the range of 100,000 T/year.

AGP produces AminoPlus® HBPSM at its crush plants in Mason City IA and Hastings NE. Like Cargill, the AGP plants are solvent plants and most of the production is conventional soybean meal. Together they probably produce about 100,000 T/year of HBPSM.

Grain States Soya at West Point NE, another expeller plant, produces HBPSM marketed under the Soy Best® brand name. The plant was established in 1958 and has been gradually expanded over the years. Current production capacity is 75,000 T/year.

Together these five plants probably produce 500,000 to 550,000 T/year of HBPSM.

If HBPSM simply displaced conventional soybean meal in dairy rations, there would be no net gain in soybean meal consumption by increasing its use. However, when used properly, HBPSM does not displace conventional soybean meal, but fills a different need in the ration of a high producing dairy cow.

Conventional soybean meal provides primarily rumen digestible protein. The role of HBPSM is to provide additional amino acids for absorption in the small intestine. For this place in a dairy ration, HBPSM competes with other high bypass feed ingredients, such as blood meal, fish meal and porcine meat & bone meal. Since conventional soybean meal has only about 40% rumen undegradable protein (RUP), it is not suitable for providing the "extra" amino acids to the small intestine, since too much of it would be degraded in the rumen. By comparison, HBPSM has 60-74% RUP.

If a dairy ration is high in alfalfa (which has 17-20% protein, but only 18-20% RUP), the ration might include very little conventional soybean meal (perhaps as little as 1 pound/cow/day) and as much 4 pounds/cow/day of HBPSM (or competing high bypass protein ingredient). If the ration is high in corn silage (which has only 8-10% protein, but 30-40% RUP), it might contain 4 pounds/cow/day (or even more) of conventional soybean meal as well as 4 pounds/cow/day of HBPSM (or competing high bypass protein ingredient).

If one assumes that 30% of dairy cows are consuming HBPSM at an average rate of 2 pounds/cow/day, consumption of HBPSM in the six states of the Upper Midwest would be as follows:

- Minnesota – 450,000 head x 30% x 2 pounds/cow/day = 49,000 T/year
- Wisconsin – 1,243,000 head x 30% x 2 pounds/cow/day = 136,000 T/year
- Iowa – 205,000 head x 30% x 2 pounds/cow/day = 22,000 T/year
- South Dakota – 81,000 head x 30% x 2 pounds/cow/day = 9,000 T/year
- Nebraska – 61,000 head x 30% x 2 pounds/cow/day = 7,000 T/year
- North Dakota – 32,000 head x 30% x 2 pounds/cow/day = 4,000 T/year
  6-state total – 2,072,000 x 30% x 2 pounds/cow/day = 227,000 T/year

However, this is only a "guesstimate." Thirty percent of dairy cows being fed HBPSM is only an estimate, and feeding rates can vary considerably depending on competitiveness with other high bypass proteins. If the feeding rate were 3 pounds/cow/day rather than 2 pounds/cow/day, consumption in the 6-state region would be half again as much, or 341,000 T/year. And if 35% of dairy cows (rather than 30%) were consuming 3 pounds/day of HBPSM, the figure would jump to 397,000 T/year. The lower figure of 220,000 T/year is considered a "safe" estimate, while an upper figure of 397,000 T/year is probably optimistic. The actual figure is probably somewhere in the middle, around 300,000 T/year, but widely variable around that figure.

Although estimated production of up to 550,000 T/year of HBPSM in the Upper Midwest seems like an oversupply situation compared with 227,000 to 397,000 T/year of consumption in the region, a lot of HBPSM produced in the region is shipped out of it. California, the #1 dairy state, with 43% more dairy cows than #2 Wisconsin, could consume 195,000-341,000 T/year of HBPSM (again using the variables of 30% or 35% of dairy cows consuming it, at rates of 2 or 3 pounds/cow/day). Another large western dairy state, #5 Idaho, with 8% more dairy cows than #6 Minnesota, could consume 53,000-93,000 T/year. Colorado, Oregon and Washington have 465,000 dairy cattle among them, or about the same number as Minnesota. That equals another 50,000-88,000 T/year of HBPSM consumption. Most of the consumption of HBPSM in these Western states would come from the plants in the Upper Midwest.

Summarizing, the producers of HBPSM in the Upper Midwest can produce 550,000 T/year while consumption of HBPSM in the Upper Midwest and the five western states mentioned above is in the range of 520,000 to 910,000 T/year. Therefore, supply of and demand for HBPSM appear to be in fairly good balance , with the supply situation being tight when HBPSM is price-competitive with other high bypass proteins and feeding rates are higher.

Of course the market for HBPSM would be much larger if more than 30-35% of dairy operations used it. Those interviewed for this study said that usage of HBPSM has increased over the past few years as consolidation in the dairy industry has created larger, more sophisticated operations. So there certainly appears to be a lot of upside potential for HBPSM.

Impediments to increased use of HBPSM include:

- *Cost*. HBPSM costs about $50/T more than conventional soybean meal. Some dairy operations will always pursue a least-cost feeding program, regardless of cost-benefit analyses.
- *Unavailability*. HBPSM is a specialty ingredient produced only at a handful of soy crush plants in the Upper Midwest. This means that the product isn't always available.
- *Lack of education about and/or adequate promotion of the product*. Producers of HBPSM have done a lot of promotion of their product, but there always will be those who don't get the word.
- *High transportation costs* from producers in Iowa and Nebraska to dairy operations in Minnesota and Wisconsin.
- *Inconsistent % of RUP*. Underheating/toasting or uneven heating/toasting is usually the reason for this.
- *Inconsistent % of intestinal absorbable protein*. Overtoasted HBPSM may bypass the rumen fine, but if the protein is not absorbable in the small intestine, nothing is gained, and more waste is produced.
- *Increased feeding of ethanol co-products*. DDG has about 50% RUP and is notoriously inconsistent in both RUP and intestinal absorbable protein. However, there is a lot of it available today at very competitive prices, so dairy operations use a lot of it.
- *Feeding of roasted soybeans*. These often are considered to have high bypass protein, but a University of Minnesota study found them to be only 39.4% RUP, compared with 30.4% for raw soybeans. As with all products that get their bypass quality by heating, inconsistency of RUP and intestinal digestibility are concerns. Also, the fat content of whole soybeans is 18-19%, which is higher than recommended for a dairy cow. But it still is a very common practice. Indeed, the USDA/NASS study found that 31% of dairy operations surveyed feed roasted soybeans.

Feeding of HBPSM is increasing as dairy operations become larger and more sophisticated. Both producers and users of HBPSM confirm this trend, which is likely to continue.

There are two large concentrations of dairy cattle in Minnesota: one in the area between St. Cloud and Fergus Falls in central and west central Minnesota, and the other in the extreme southeast corner of the state.

There are approximately 190,000 dairy cows in Minnesota's Northwest Agricultural Statistics District, North Central District, and northern halves of the West Central and Central Districts, which would be the primary market for a producer of HBPSM located along I-94 between St. Cloud and Fergus Falls. Using the same assumptions of 30% of dairy cows being fed a ration with 2 pounds/cow/day of HBPSM, consumption would be 21,000 T/year. If the feeding rate were 3 pounds/cow/day, consumption would increase to 32,000 T/year. An expeller plant with capacity of only 125 T/day could produce this much HBPSM. That is quite a small expeller plant to be economically viable.

There are approximately 107,000 dairy cows in Minnesota's Southeast Agricultural Statistics District. In addition, there are approximately 419,000 dairy cows in Wisconsin's Northwest, North Central and West Central Agricultural Statistics Districts, which includes Wisconsin's #1 and #2 dairy counties, Marathon and Clark, in the central part of the state. These 526,000 cows could consume 58,000 to 86,000 T/year of HBPSM. The higher figure would require a plant with crush capacity of 300 T/day, which is a reasonable size for an expeller plant.

A case could be made for pursuing an expeller plant with capacity of around 300 T/day in the southeast corner of Minnesota. While this may be beneficial to the local soybean industry, this will address the "bigger picture" of needing to process more soybeans to provide more soybean oil to the emerging biodiesel industry only if it increases the use of HBPSM, rather than just displacing HBPSM that is currently coming into the area from Iowa. In other words, the size of the pie has to grow, not just a reallocation of the pieces of the pie.

There is reason to believe that increased consumption of HBPSM would happen if there were a nearer supplier. Although any point in the target market area would be only 100 miles nearer to a plant in, for example, the Rochester area, than to the AGP plant in Mason City, the distance widens out to 210 miles when compared with Des Moines, and to 235 miles when compared with Ralston.

A first step in pursuing an expeller plant is southeast Minnesota might be to conduct a thorough survey of dairy operations in southeast Minnesota and the northwest quadrant of Wisconsin, to determine how much HBPSM is being consumed in the area, where it is coming from, and how much additional HBPSM might be consumed in the area if there were a nearer supplier.

Another possibility would be for one of the existing soybean crush plants to add the capability to produce HBPSM. But none has, even though they are aware of the product and have been faced with a great oversupply of conventional soybean meal in Minnesota since the start-ups of the plants at Brewster and Fairmont nearly four years ago. If any of them saw adding HBPSM production capacity as a means to address this oversupply situation, one would think that they would have done so by now.

Conclusion

With the advent of biodiesel, demand for vegetable oil during the next decade is likely to increase even more rapidly it did during the past decade, when worldwide consumption of oils and fats increased by 66% while worldwide population increased by only 15%.

Soybeans have been the predominant oilseed in USA for many years, accounting for 90% of total oilseed production in 2006, with soybean oil accounting for 55% of total oils and fats production and 78% of total vegetable oil production. Therefore, it is logical that biodiesel industry in USA has been predominantly soybean oil-based.

But when soybean oil is produced, so is soybean meal, and finding homes for large additional soybean meal production will be challenging. Domestic consumption is growing slowly and high priced corn and soybean meal are cutting into profits of the livestock and poultry industries, discouraging expansion. Argentina has become the primary soybean meal supplier to world markets.

Soy flour and HBPSM are alternative products to conventional soybean meal. Expansion of the use of either would contribute toward the need to find more homes for the meal side of the equation. Both products have been around for many years and neither seems to be poised for rapid expansion.

A 300 T/day expeller plant in southeast Minnesota producing HBPSM to serve the dairy industry in that corner of the state and in the northwest quadrant of Wisconsin and producing soybean oil to serve stand-alone biodiesel plants in Minnesota and Wisconsin might be economically viable. Dairy operators in the region are currently obtaining their HBPSM from crush plants in Iowa and Nebraska.

A logical start would be to conduct a thorough survey of dairy operators in the region to determine how much HBPSM they are using, where it is coming from and how much more would be consumed in the region if there were a nearer supplier.

Introduction

Purpose

As stated in the services agreement between Agricultural Utilization Research Institute (AURI) and Robert W. Carlson, the purpose of this study is to "…define the market size for soybean by-pass proteins and soy-flour extracts. The assessment would look to the international and domestic markets for soy-flour utilization and opportunities. The by-pass protein market currently utilizes by-pass protein from expeller plants and hexane extraction plants. This assessment would define market differentials between the two by-pass protein products and identify the market size in the upper Midwest."

Disclaimer & indemnification

Robert W. Carlson has used his experience in and knowledge of the oilseed industry to prepare this study and has reached its conclusions in an objective and unbiased manner. There is no assurance given, nor should any be inferred by Agricultural Utilization Research Institute (AURI), or anyone with whom AURI shares this study, that any projections or forecasts made by this study, or implied by it, will in fact be realized.

Background

Expansion of the biodiesel industry

With the rapid expansion of the biodiesel industry in the United States over the past few years, particularly that segment of the industry that plans to use soybean oil as its primary feedstock (which is most of the industry), the demand for soybean oil soon could outstrip the domestic soybean crushing industry's production capacity.

As of September, 2007, the National Biodiesel Board (NBB) listed the following biodiesel plants whose primary feedstock is or will be soybean oil:

- 61 operating plants with combined capacity of 707 million gallons/year (MG/Y)
- 28 plants under construction or expansion with combined capacity of 680 MG/Y

All of the plants under construction or expansion should be operating by the end of 2008. The combined capacity of these plants and those that already are operating is 1.387 billion gallons/year (BG/Y). It would require 5.2 million tons of soybean oil to operate all this capacity. This is 50% of annual soybean oil production in USA.

[NOTE: Among the operating plants, there are six with combined capacity of 171 MG/Y that are co-located with soybean crush plants; among the plants under construction, there are six with combined capacity of 275 MG/Y that will be co-located with soybean crush plants.]

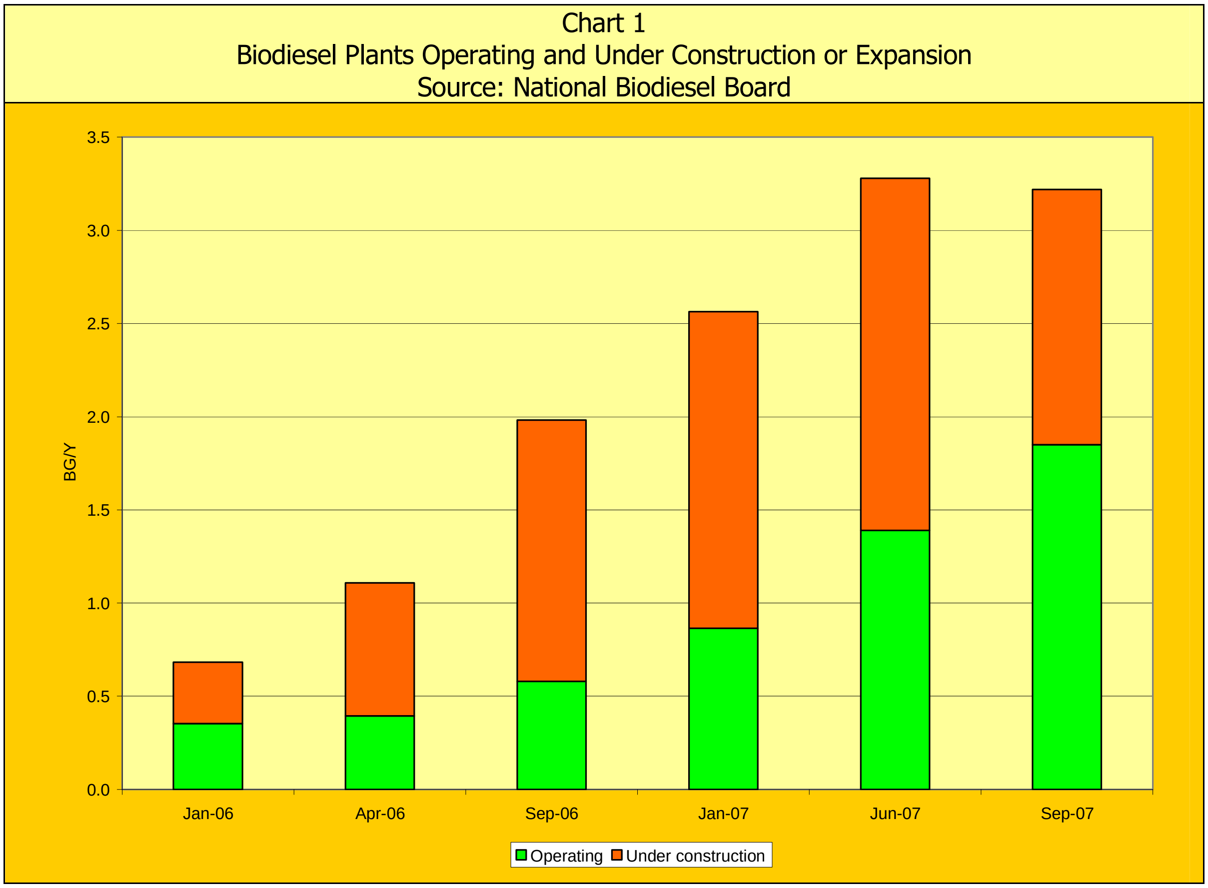
In addition, the NBB list includes five more operating biodiesel plants and another two that are under construction or expansion which did not disclose their capacity to NBB and whose primary feedstock is listed as soybean oil. Generally these are small capacity plants. But NBB's list also includes several plants, some of which are large, that list the capacity but not the feedstock, or that are listed as "multi-feedstock." Surely there is some soybean oil included in this.

NBB estimates the capacity of all 165 biodiesel plants (regardless of feedstock) that were operating as of September, 2007, including those that did not disclose their capacity, to be 1.85 BG/Y. It also estimates the capacity of all biodiesel plants that were under construction (80 plants) or expansion (4 plants) as of September, 2007, including those that did not disclose their capacity, to be 1.37 BG/Y. This means that there could be 3.22 BG/Y of operating biodiesel production capacity in place by the end of 2008.

Finally, there are a number of biodiesel plants which have been announced that intend to run primarily on soybean oil but are not yet included in NBB's listings since they are not yet in the construction stage.

Certainly not all plants in the "pre-construction" stage will be built. Even some that NBB lists as under construction possibly will not be completed. But it is fairly safe to say that by the end of 2008 there will be at least 3 BG/Y of biodiesel production capacity in place in USA, with not nearly enough feedstock to be able to run it at anywhere close to capacity, even if there were demand for this much biodiesel.

[NOTE: The most recent listings of biodiesel plants released by NBB showed for the first time that expansion of the industry has leveled off, with the amount of capacity under construction or expansion declining from 1.89 BG/Y in June to 1.37 BG/Y in September, a decline of 0.52 BG/Y. Between June and September another 0.46 BG/Y came on line, accounting for most of the decline in capacity under construction or expansion, as it moved from one category to the other. However, unlike in previous lists, no new capacity entered the under construction or expansion category between June and September. The number of operating plants increased by 17 between June and September, and the number of plants under construction or expansion declined by 17. See Chart 1 on the next page.]



The need for more soybean oil

The vast majority of soybean oil produced in USA is currently used for domestic food consumption. Therefore, the production of soybean oil will have to be increased greatly if the demand for both food and energy is to be satisfied.

One possibility is increasing the percent of oil in soybeans. The oil content of soybean is typically about 19%. This compares with 40% or more in high oil contents oilseeds like canola and sunflower. Research is being done to increase the oil content of soybeans, but significant increases are likely many years away.

Another possibility is to increase soybean crushing capacity in USA significantly. There is no doubt that USA produces enough soybeans to support an expanded crushing industry. Indeed, about a third of the annual crop of 90 million tons (3 billion bushels) is exported. Presumably if crushing margins are good due to increased demand for oil, domestic crushers will be able to keep the additional volume of soybeans they need in the country.

Expansion of the domestic soybean crushing industry is in fact taking place to meet the increased demand for oil. After no new crush plants being built between 2004 and 2006 (the last two new soybean crush plants built in USA were the CHS plant in Fairmont and the Minnesota Soybean Processors plant in Brewster, both of which began operations in the fall of 2003), several new plant constructions or expansions were begun or announced in 2006:

- Louis Dreyfus at Claypool IN—5,000 T/day crush plant with same-sized (80 MG/Y) biodiesel plant; announced in March, 2006; will be Dreyfus's first crush plant in USA; scheduled to be in production in October, 2007.
- Prairie Pride at Deerfield MO—2,000 T/day crush plant and same-sized (3 MG/Y) biodiesel plant; broke ground on August 5, 2006; scheduled to be in production in December, 2007.

- Cargill at Kansas City MO—5,000 T/day crush plan, to replace existing 3,000 T/day plant, with 40 MG/Y biodiesel plant (under a joint venture known as Paseo Biofuels) and glycerin refinery; announced in June, 2006; scheduled to be in production in December, 2007.
- Bunge at Council Bluffs IA—expansion to 6,500 T/day from 5,600 T/day, announced on October 24, 2006; to bring crushing capacity more in line with refining capacity
- ADM announced in November, 2006, that it will expand the capacity of five soybean crush plants in USA (Quincy IL, Frankfort IN, Mexico MO, Fremont NE and Des Moines IA) as well as two canola crush plants in North America (Velva ND and Lloydminster, Alberta, Canada) by mid 2008, citing "a growing population which increased demand for food worldwide, rising global wealth which is changing protein and oils consumption, and increasing global energy needs and energy security concerns that promote biodiesel demand."
- On June 26, 2007, a joint venture between International Bio Fuels Corporation and Consolidated Biofuels announced plans to build a 6,250 T/day soybean crush plant and 150 MG/Y biodiesel plant on the Mississippi River in Chicot County, Arkansas, in the extreme southeast corner of the state. However, this project is only in the conceptual stage at this point, which is a long way from becoming reality.

All of the above represents an expansion of domestic soybean crushing capacity of about 21,000 T/day (700,000 bushels/day), depending on the size of the ADM expansions, which they did not disclose. This would be an expansion of nearly 13% of an industry with current capacity of 165,000 T/day (5.5 million bushels/day). But even all of this increased crushing capacity won't produce enough additional oil to meet current food demands and increasing biodiesel feedstock demands. All of the new capacity listed above will be capable of producing about 1.4 million tons of soybean oil per year, which is far less than the 5.2 million tons that would be needed by all the biodiesel plants currently operating or under construction or expansion that plan to use soybean oil as their feedstock.

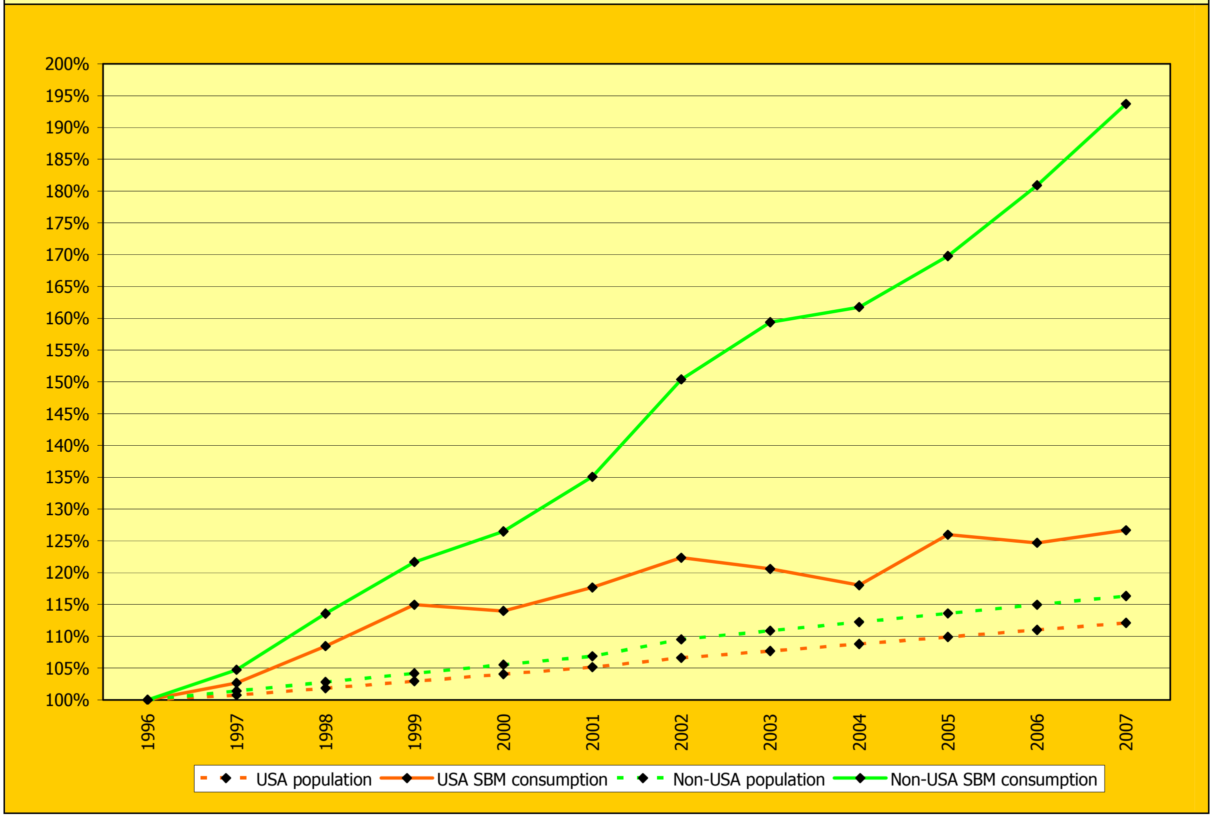
What about the meal?

The new capacity listed above will produce over 5 million T/year of soybean meal. Finding homes for all this meal won't be easy. And if domestic soybean crush is to be expanded even further in order to meet the demand for soybean oil as a biodiesel feedstock, new markets are going to have to be found for the additional soybean meal that also will be produced.

Consumption of soybean meal worldwide, exclusive of USA, has expanded by 94% since 1996, as rising standards of living in the developing world have resulted in increasing demand for meat, milk and eggs. Soybean meal is the primary protein ingredient used in the feeding of all types of livestock, poultry and fish. The increased consumption of soybean meal greatly outpaced the worldwide increase in population (again excluding USA) during the same period, which has seen an increase of only 16%.

However, during the same period, soybean meal consumption has expanded by only 27% in USA, while population has increased by 12%. See Chart 2 on the next page.

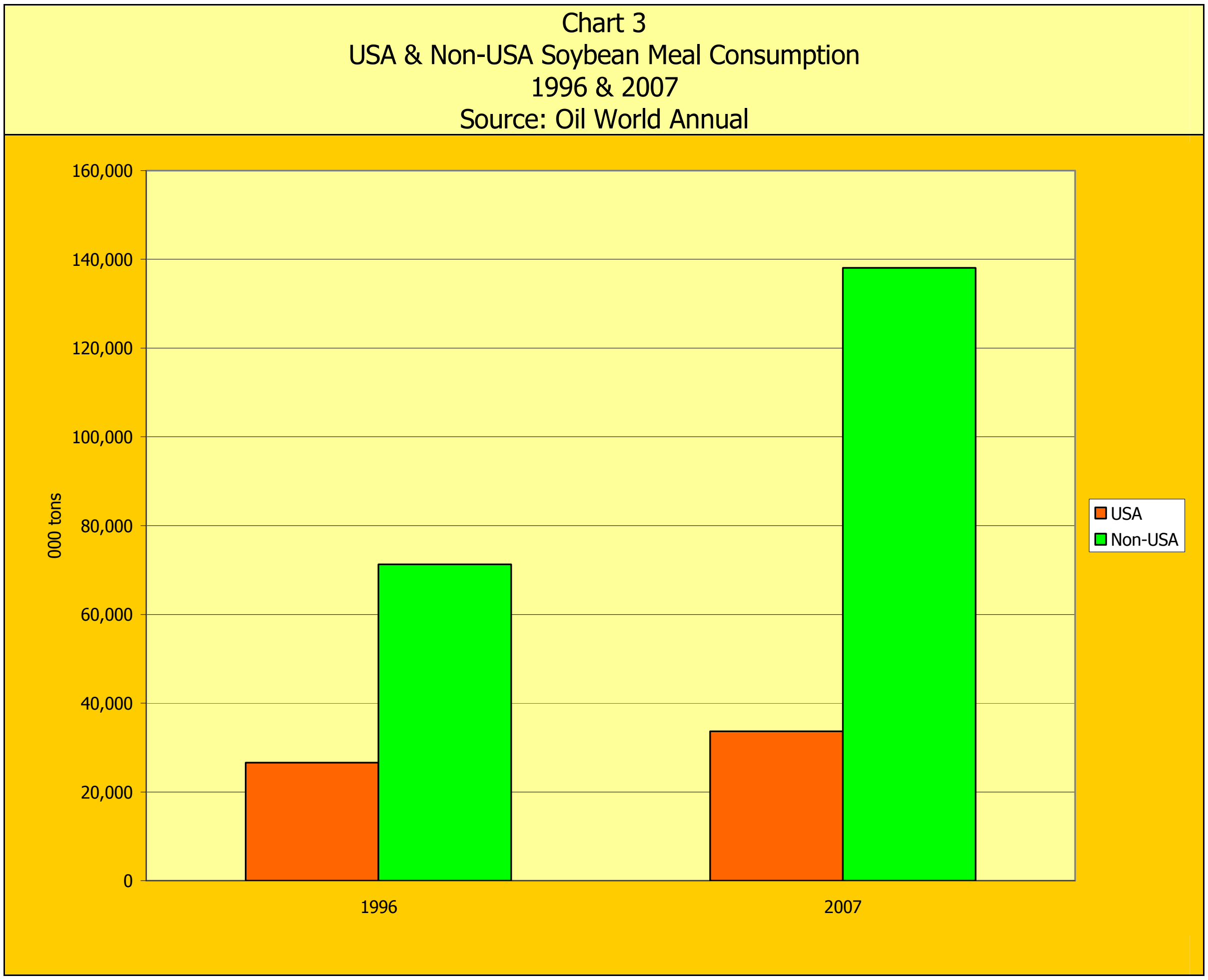
Chart 2
Changes in USA & Non-USA Population & Soybean Meal Consumption
1996 - 2007
Source: Oil World Annual



In absolute terms, soybean meal consumption in USA increased from 26.6 million tons in the marketing year that ended September 30, 1996 to 33.7 million tons (projected) in the marketing year that ended September 30, 2007, or an increase of 7.1 million tons over the 11-year period.

In the rest of the world, soybean meal consumption increased from 71.3 million tons in the marketing year that ended September 30, 1996 to 141.4 million tons (projected) in the marketing year that ended September 30, 2007, or an increase of 70.1 million tons over the 11-year period.

Viewed another way, USA accounted for 27.2% of worldwide soybean meal consumption in 1996. In 2007, it will account for only 19.6%. So the big growth in soybean meal markets is clearly in the rest of the world. See Chart 3 on the next page for a graphic depiction of this shift in world soybean meal consumption.

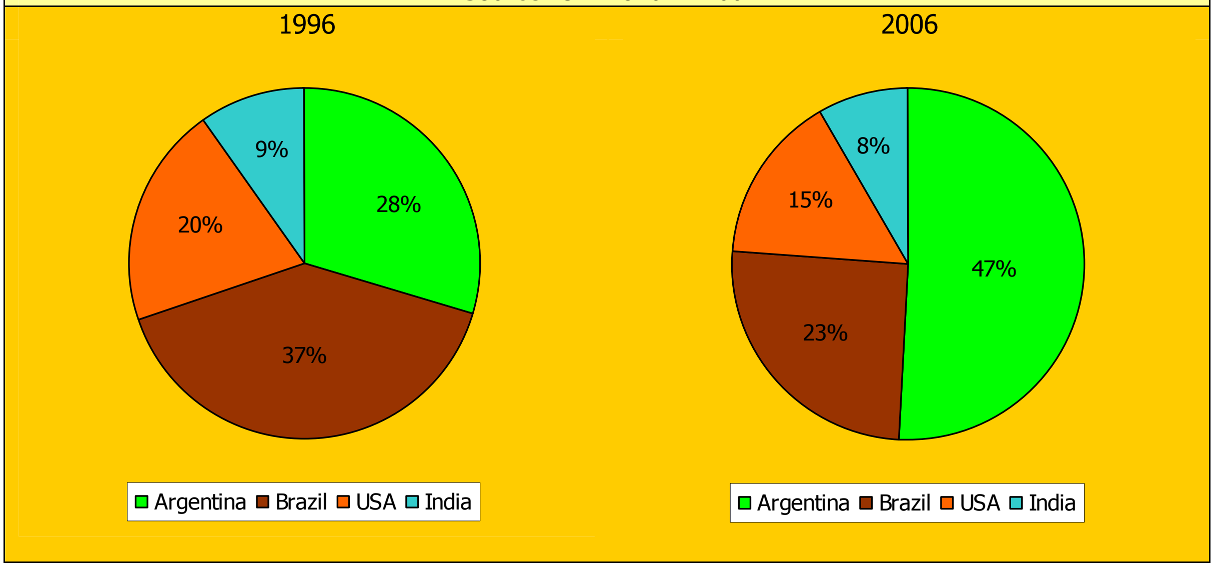


As mentioned, consumption of soybean meal in USA is expected to reach 33.7 million tons in 2007. But enough additional soybean crushing capacity to produce enough soybean oil to produce 1.4 BG/Y of biodiesel also would produce about 20 million tons of soybean meal. Even if additional soybean oil were needed to produce only 1 BG/Y of biodiesel (which would equal about a 2% biodiesel blend nationwide), this would mean that another 14 million tons of soybean meal would be produced. During the past decade, soybean meal consumption in USA increased by 7.1 million tons. At this rate of growth, it will be at least 20 years before another 14 million tons of soybean meal is being consumed domestically.

Compounding this problem is the fact that the expanding biofuels industry (both biodiesel and ethanol) has driven the price of feed ingredients to levels that jeopardize the profitability of livestock and poultry production. If this continues to be the case, the rate of growth in domestic soybean meal consumption in the next decade may not even keep pace with that of the past decade.

Given this situation, a logical place to look in order to dispose of increased production of soybean meal would be the rapidly expanding international market. However, Argentina has become the dominant force in the world soybean meal market, accounting for 47% of soybean meal that entered world trade in 2006, up from 28% in 1996. During the same period, USA's share of world trade in soybean meal has declined from 20% to 15%. See Chart 4 on the next page.

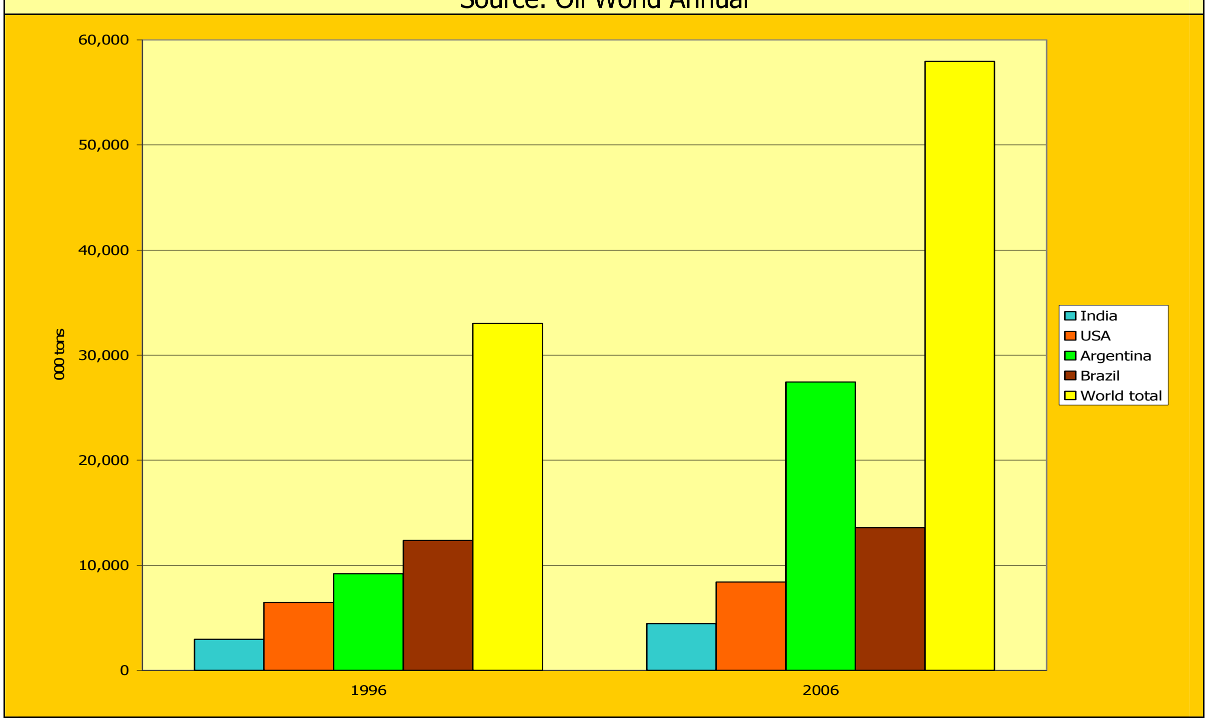
Chart 4
Share of World Trade in Soybean Meal
1996 & 2006
Source: Oil World Annual



[NOTE: Argentina, Brazil, USA and India accounted for 94% and 93% of soybean meal exports in 1996 and 2006, respectively.]

In absolute numbers, USA soybean meal exports increased by 2 million tons between 1996 and 2006. During this same period, soybean meal exports by the rest of the world increased by 23 million tons. See Chart 5 for a graphic depiction of this situation.

Chart 5
World Trade in Soybean Meal
1996 & 2006
Source: Oil World Annual



Of the total increase of 25 million tons of world trade in soybean meal between 1996 and 2006, Argentina accounted for 18 million tons or 72%. USA accounted for 2 million tons (8%), India accounted for 1.5 million tons (6%) and Brazil accounted for 1 million tons (2%). This trend is expected to continue, with Argentina claiming a larger and larger share of world soybean meal trade.

So as in the case of domestic soybean meal consumption, it is hard to imagine that an additional 14-20 million tons of USA soybean meal production is going enter world trade annually any time soon (if ever), in order to enable enough new USA soybean crushing capacity to be built to produce the feedstock for 1-1.4 BG/Y of biodiesel.

The situation in Minnesota

The situation in Minnesota is similar to that in USA in general, except more so. The five major soybean crush plants in Minnesota (ADM at Mankato, CHS at Fairmont and Mankato, AGP at Dawson and Minnesota Soybean Processors at Brewster) are capable of crushing about 180 million bushels/year, which is 60% of Minnesota's normal annual soybean crop of about 300 million bushels. So there is no shortage of soybeans to process. But a crush of 180 million bushels produces about 4 million tons of soybean meal, while consumption within the state is about half this amount. So Minnesota processors need to find homes outside of the state for about half the meal they produce. This can be difficult to do, given Minnesota's location and traditionally low protein content of its soybean crop, meaning that meal produced in Minnesota must compete with meal produced in other states that has 1-1.5% higher protein content.

So if the soybean crushing industry in Minnesota is going to expand to meet increasing demand for soybean oil as a biodiesel feedstock, the new plants probably will need to produce something other than conventional soybean meal. This study examines two such alternatives to conventional soybean meal: soy flour and bypass protein soybean meal.

Soy Flour

Producers

Soy flour is a highly nutritious food ingredient that has been used for many years. There are only three producers of defatted soy flour (DSF) in USA: ADM at one of its soybean crush plants in Decatur IL; Cargill at one of its soybean crush plants in Cedar Rapids IA; and CHS at its soybean crush plant in Mankato. Production data are not shared, but the consensus is that ADM and Cargill are a close #1 and #2 (in either order), with CHS being #3.

ADM refers to its three types of DSF as 7B, Baker's and Toasted. Cargill's has branded its DSF as Prolía®. CHS has branded its DSF as Honeysoy®.

AGP used to produce DSF at its soybean crush plant in St. Joseph, Missouri, but exited the business about five years ago.

The other major soybean crusher in USA, Bunge, does not produce DSF, but they are a major player in the growing soy concentrates and isolates business.

[NOTE: Soy flour also can be made from whole soybeans, without first removing the oil (fat) content. However, since this study stems from the need to find alternative uses for the meal fraction of the soybean after the oil has been removed, to satisfy the increasing demand for soybean oil, non-defatted soy flour does not play a role in this study.]

Production process

The production of DSF is identical to that of dehulled soybean meal up to the point at which the oil has been removed from soy flakes in the extractor and the flakes have left the extractor to be desolventized. Soybean meal is desolventized in a vessel called a desolventizer-toaster (DT), which exposes defatted, but still solvent-laden, soy flakes to both indirect heat and direct contact with steam. This raises the temperature of the solvent (hexane) in the flakes to the point where it is vaporized. It also toasts the flakes to destroy enzymes that could be harmful in animal feeds. The hexane vapors are then collected and condensed to liquid form for reuse in the extractor.

If soy flakes are to be made into DSF, they must be desolventized by another method, in order to retain a high protein dispersibility index (PDI). Typically this is done by a method called flash desolventizing, in which the flakes come in contact with hot hexane vapors. The desolventized flakes (called white flakes) can then either be ground into DSF or used in the production of soy concentrates and isolates. *[NOTE: ADM produces soy concentrates and isolates in addition to DSF; Cargill and CHS do not. Cargill entered the business five years or so ago at its soy crush plant in Sydney OH but has since sold the business to Solae. See page 12 for a comment on Solae.]*

DSF has protein content of about 54% on a dry matter basis. Soy concentrates further concentrate the protein by removing a portion of the carbohydrates, with the resulting product having a minimum protein content of 65% on a dry matter basis. Soy isolates use a water extraction process to further concentrate the protein, with the resulting product being nearly carbohydrate- and fat-free. Soy isolates have a minimum protein content of 90% on a dry matter basis.

Applications

Although soy flour has nutritional benefits, it is used primarily for its functional benefits. When incorporated into bread dough, it enables the bread to retain more moisture during the baking process, thereby increasing yield. Thus, it is a money-maker for the baker. It also extends shelf life by decreasing the rate of staling. When used in doughnuts, soy flour absorbs less oil, which is a relatively expensive ingredient, thus saving costs. The rate of incorporation in bread dough and doughnuts is usually in the range of 2-4%.

In addition to baking applications, soy flour can be “texturized” and made into meat analogues, such as ground beef extender and imitation bacon bits.

Besides the nutritional and functional benefits of soy flour, certain health claims have been made about soy protein in general. These include:

- Lowering blood cholesterol
- Decreasing osteoporosis
- Alleviating menopausal symptoms
- Decreasing incidence of some kinds of cancer, particularly prostate and colon

Some research has supported these claims while other research has not.

Soy flour also has industrial applications, primarily as a binding agent in composite materials. One Minnesota company, the now-defunct Phenix Biocomposites, made a "looks like granite" product from recycled newsprint and soy flour at its factory in Mankato until going bankrupt a few years ago. A representative of the successor company, Environ Biocomposites stated that "we are not currently producing the Environ…product. We are selling off the large amount of existing inventory that is still available in selected colors. Environ is not currently using any soy-based products in the manufacture of its other products." *[NOTE: Ironically, Environ was the trademark name that Phenix Biocomposites gave its "looks like granite" product. The successor adopted Environ as its company name, but no longer makes the namesake product.]*

An excerpt from CHS's website:

Commercial food processors and bakers have long understood the functionality of soy flour. It helps retain moisture, whitens crumb color and shortens baking time. It can extend the shelf life of a loaf of bread or decrease fat absorption in donut production. Soy flour is widely used today in beverages, sauces, soups, cereals, and as part of meat, egg or milk replacers.

Distributed under the Honeysoy® brand name, CHS markets soy flour in bulk and bags domestically and abroad. International distribution is predominantly to eastern European countries where bread, not meat, is the diet mainstay. Soy flour is an excellent low-fat source of isoflavones and protein, providing all eight amino acids necessary for human health.

An excerpt from Soyfoods.com website:

Although soy flour has not yet found its way into many family kitchens, it is used extensively by the food industry. Soy flour turns up in an amazing array of food products, including fudge and other candies, pies, doughnuts, cakes and rolls, pasta, pancake mixes and frozen desserts. Some meat loaves and other prepared meat products use soy flour.

Soy flour gives baked goods a protein boost. It also keeps baked goods from becoming stale. In fried foods, like doughnuts, soy flour reduces the amount of fat that is absorbed by the dough. It adds a rich color, fine texture, tenderness and moistness to baked goods. Since soy flour is free of gluten, which gives structure to yeast-raised breads, soy flour cannot replace all of the wheat or rye flour in a bread recipe. However, using about 15 percent soy flour in a recipe produces a dense bread with a nutty flavor and a wonderful moist quality.

In baked products that are not yeast-raised, up to 1/4 the total amount of flour called for in the recipe can be replaced with soy flour. Recipes that are developed to use soy flour specifically can often use it in even higher amounts.

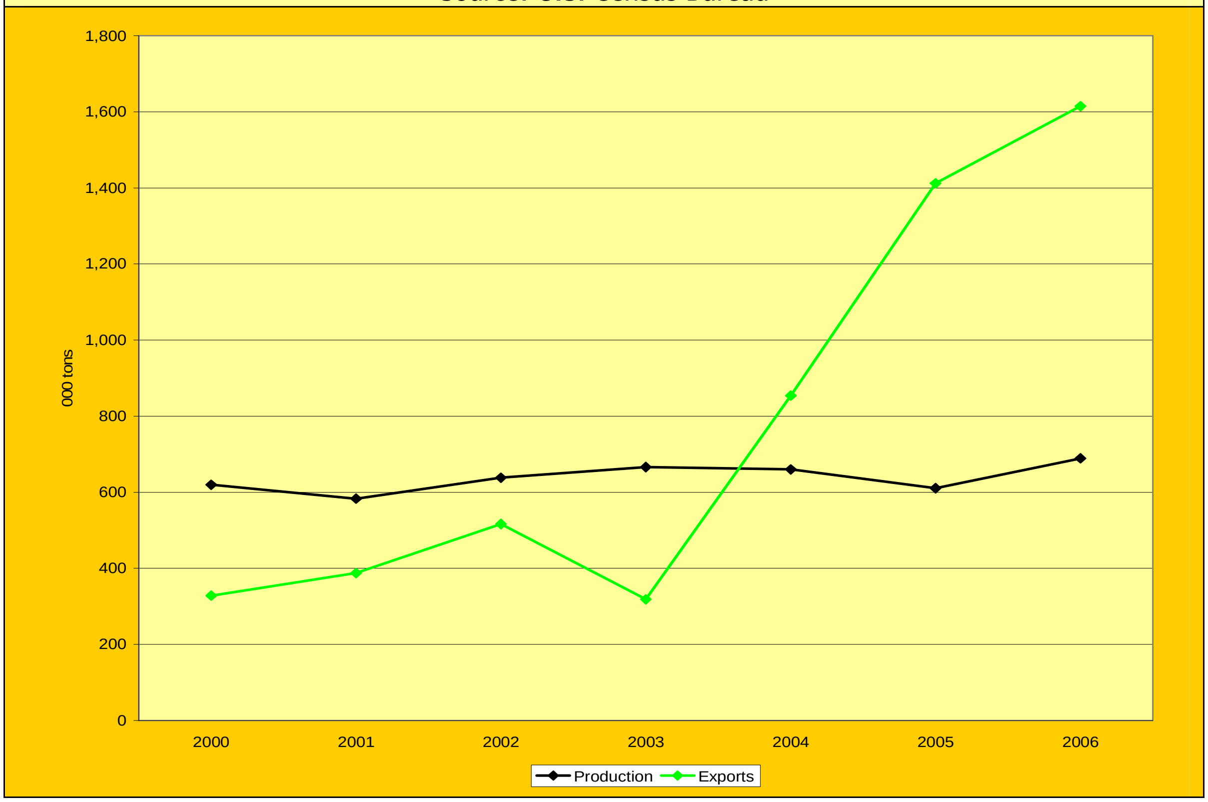
Because it adds moisture to baked products, soy flour can also be used as an inexpensive and cholesterol-free egg substitute in these foods

Markets

With only three producers of DSF, the industry is not "transparent," with producers of DSF being unwilling to disclose production figures or pricing. The price usually is within a range of 100-150% that of wheat flour. No reliable statistics are available for production or consumption of soy flour. The National Oilseed Processors Association does not track soy flour production. While export statistics are available, soy flour is commingled with soy concentrates and isolates, making it impossible to isolate soy flour statistics.

The U.S. Census Bureau does keep production and export data for "edible protein" under the general category of "soybean cake and meal." Edible protein includes all three primary products made from white flakes: soy flour, concentrates and isolates. However, reporting is voluntary and there could be reluctance by the three producers of DSF to provide accurate figures, so as not to disclose information that could be valuable to their competitors.

Chart 6
Edible Protein Production & Exports
Source: U.S. Census Bureau



Notice that exports increased sharply beginning in 2004…even to the point where they exceeded production! How is this possible? USDA/ERS and one of the producers of DSF both speculated that the reason for this is misclassification of soybean meal exports as soy flour exports beginning in 2004. This could be done at the request of the overseas customer, due to the duty structure in the receiving country being more favorable to imported soy flour than imported soybean meal.

Another industry source believes that the production figure is being significantly under-reported and that there are at least million tons of white flakes being produced annually, with about 650,000 tons being converted to soy concentrates and isolates. This would leave 350,000 tons as soy flour

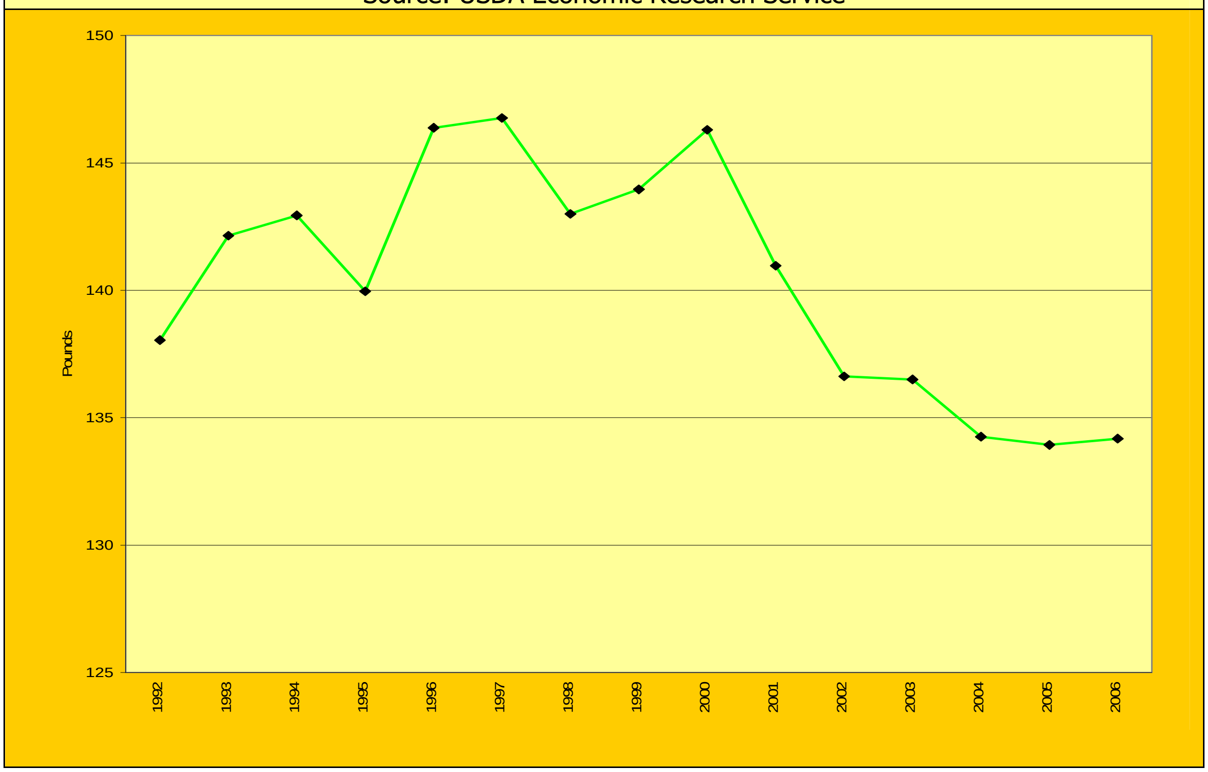
Another industry source pegs the production of soy flour at 540,000 T/year.

One producer of soy flour said that the domestic market consumes more than is exported, and the domestic market itself is more soy flour than texturized soy flour. That producer also called the market "mature and very competitive," growing at a rate of perhaps 2-3% annually.

USA consumes 20 million tons of wheat flour annually. If the production figure for soy flour of 540,000 T/year is correct, and if the export market is 140,000 T/year (which is only a "guesstimate"), that would leave 400,000 T/year for domestic consumption. And if 100,000 T/year of this is texturized (again a "guesstimate"), that would leave 300,000 T/year for the domestic baking industry. This is 1.5% of the 20 million T/year of wheat flour that is consumed domestically. This is reasonable, given that blend rates are usually in the 2-4% range, in those cases when soy flour is being used.

However, if the primary "driver" for domestic consumption of soy flour is its use as a complementary ingredient to wheat flour in breads and doughnuts, one cannot get very encouraged about the growth of that segment of the industry. Chart 7 shows that per capita consumption of wheat flour in USA declined by ten pounds/year (about 7%) between 2000 and 2002, due to the Atkins Diet craze. After slipping a little more from 2002-2004, the decline has leveled off, but a rebound has not yet occurred. Until it does, soy flour lacks the "vehicle" it needs to increase domestic consumption significantly.

Chart 7
Per Capital Consumption of Wheat Flour in USA
Source: USDA Economic Research Service



Outlook

Although accurate statistical information for soy flour production and consumption is not available, if the reported production of edible protein shown in Chart 6 is "consistently flawed," (that is, the same producers reporting, with a consistent degree of accuracy…or inaccuracy), the industry has not grown much since 2000. Production in 2000 was 619,300 tons and in 2006 was 689,000 tons, an increase of only 11% over the 7-year span.

Even if white flake production is 1-1.5 million T/year, it is a very small part of the larger soybean processing industry. This is only 2.4-3.6% of the amount of soybean meal produced in USA this year.

Growth in the domestic soy flour market seems limited to growth in consumption of wheat flour, which has actually declined on a per capita basis since 2000 (and even on an absolute basis, as consumption of wheat flour in 2006 was 2.6% less than in 2000).

On the export side, soy flour has been promoted through efforts such as the World Initiative for Soy in Human Health (WISHH). A press release in November, 2006, documented that collaboration between CHS and WISHH resulted in CHS introducing soy flour to Kenya. And the Baking with Soy Short Course at the Northern Crops Institute in Fargo in July, 2007, attracted participants from Egypt, Jordan, Oman and Pakistan, to learn about the benefits of fortifying their baked products with DSF. Attendees visited CHS's soy flour production facility in Mankato at the conclusion of the course.

However, one of the largest users of soy flour, concentrates and isolates is China, and it has been increasing its domestic production capacity of edible protein, in tandem with is rapidly increasing soybean crushing capacity.

When the day comes that more soy flour production capacity is needed in USA, it is most likely that it will be added incrementally at the plants that are already making white flakes and soy flour: ADM, Cargill and CHS (and Solae in the case of white flakes for production of soy concentrates and isolates).

However, white flake production would have to increase many times over for enough additional soybeans to be processed to meet the needs of the biodiesel industry for soybean oil feedstock. A new 3,000 T/day soy crush plant (which is the minimum size of a new solvent plant today), dedicated entirely to white flake production, would produce nearly 750,000 T/year of white flakes, or roughly half of the amount of white flakes that probably are currently being produced in USA. A crush plant of this size would produce enough soybean oil to produce about 50 MG/Y of biodiesel, which is only 3.7% of the roughly 1.4 BG/Y of soybean oil-based biodiesel production capacity that will be operational by the end of 2008.

Bypass Protein Soybean Meal

Background

Bypass protein soybean meal (BPSM) is a general term for meal that has been produced in a way that reduces degradation of the protein in the meal in the rumen of a multi-gastric animal, such as a dairy cow. This results in more of the protein "bypassing" the rumen and being converted to milk, resulting in higher milk production per cow.

On June 29 of this year USDA/NASS released its first-ever report entitled "Ethanol Co-Products Used for Livestock Feed." Although the focus of the report was on ethanol co-products, especially distillers grains, corn gluten feed and brewers grains, there also was a table regarding feeding of "additional protein sources." That table is reproduced in Table 1.

Table 1
Operations Feeding Additional Protein Sources[1]
Source: USDA/NASS report "Ethanol Co-Products Used for Livestock Feed" dated June 29, 2007

Item	Soybean Meal	Cotton-seed	Roasted Soybeans	High Bypass Soy Meal	None	Dry Protein	Other
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Dairy Cattle	72	29	31	22	8	D	5
Cattle on Feed	18	2	D	2	56	9	16
Beef Cattle	25	7	1	2	58	6	7
Hogs	84	0	4	8	7	0	3

[1] Percents will not add to 100 due to ability of the respondents to select multiple sources.
D Not enough reports to provide a statistically defensible estimate.

USDA's study found that 22% of dairy cattle operations and 8% of hog operations surveyed use high bypass soy meal as a protein source, while those which use conventional soybean meal are 72% (of dairy cattle operations) and 84% (of hog operations). Since Minnesota is large in both dairy and hog production (#6 and #3 nationally, respectively), there is a considerable amount of high bypass protein meal being consumed in Minnesota. Also, Wisconsin to the east is #2 in dairy cattle and Iowa to the south is #1 in hog production.

However, it is questionable whether or not BPSM is actually being used in hog feeds. When questioned about this practice and the results of the USDA/NASS study, a swine nutrition expert at the University of Minnesota stated: "I am not aware of any pork producers who are feeding high bypass soybean meal. I suspect that the 8% of operations that said they were feeding [it]…perhaps think hi pro soybean meal is the same as high bypass soybean meal. I see no benefit of feeding high bypass soybean meal to monogastric animals." So this study will focus only on the market for BPSM as a feed ingredient for dairy cattle.

[NOTE: For its study, NASS and the Nebraska Corn Development, Utilization & Marketing Board (an agency of the State of Nebraska) surveyed approximately 9,400 livestock operations in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin by mail in February 2007 with a second mailing two weeks later and telephone follow-up in March. This probability-based survey included dairy cattle, cattle on feed, beef cattle (cow/calf), and hogs. Each species was stratified and sampled independently to represent all livestock operations in the 12-state region. For sampling efficiency, minimum operation size thresholds were set: 20 head for dairy cattle, 50 head for cattle on feed, 10 head for beef cattle, and 25 head for hogs.]

Production of BPSM

BPSM can be made by several processes. Each produces a somewhat different product, with the main difference among them being the degree of bypass or percent of protein that is rumen undegradable protein (RUP).

Expeller process

In this process, soybeans are heated and dried to a very low moisture content (down to about 2% moisture, rather than about 10% moisture in a solvent extraction plant) prior to going through an expeller (screw press), where about 80% of available oil is removed. (By comparison, the solvent extraction process removes 95% or more of available oil.) The resulting product is meal with up to 70% RUP and is referred to as high bypass protein soybean meal (HBPSM). That is, up to 70% of the protein in the meal bypasses the rumen before being digested.

HBPSM commands a premium of up to $50 per ton over conventional soybean meal, due both to the bypass quality of the protein and to having higher fat content (5-6%) than solvent extracted meal (1-2%). The additional fat serves as an energy source in the ration and improves butterfat content of the milk.

Extruder-expeller process

In this process, soybeans first go through an extruder, where they are ruptured and converted into a mash that still retains all of the oil. The mash then goes through an expeller, where 65-80% of the available oil is removed, depending on the particular system. It is in the extruder that the bypass quality is imparted to the protein. This is done by adjusting the choke of the extruder to create more pressure and a resultant higher temperature in the barrel of the extruder.

The resulting product is meal with up to 55% RUP and is referred to as mid bypass protein soybean meal (MBPSM).

MBPSM commands a premium of about $20-$30 per ton over conventional soybean meal, again due both to the bypass quality of the protein and to its higher fat content. Also, the oil produced by this process can command a premium in the "natural" (expeller press) oil market.

Heat treatment of solvent extracted meal

HBPSM also can be made by heat treating solvent extracted soybean meal after the extraction and desolventizing steps of the process. The premium for this type of HBPSM is a somewhat less than made by the expeller process, perhaps $40/T, since the fat content of the meal is lower (the same as conventional solvent extracted meal).

Chemical and heat treatment of solvent extracted meal

HBPSM also can me made by treating solvent extracted meal with heat in combination with chemicals called lignosulfonates. Meal produced in this way can have up to 75% RUP, with fat content being the same as solvent extracted meal. It commands a premium of about $40/T over conventional soybean meal.

Producers of BPSM

There are several producers of BPSM scattered around USA. Those located in the Upper Midwest (Minnesota, the Dakotas, Wisconsin, Iowa and Nebraska):

West Central Soy (WCS), Ralston IA

Located in west central Iowa. The leading producer of HBPSM using the expeller process. Company history dates back to 1907. Began processing soybeans in 1942, when the company was known as Farmers Cooperative Association. Name was changed to West Central Cooperative in 1979 and to West Central Soy a few years ago. Introduced HBPSM in 1984 under the brand name of SoyPLUS®. Plant was expanded to 600 T/day in 1992 and to 900 T/day in 1997. Can produce 250,000 T/year of HBPSM if operating at capacity. *[NOTE: A study conducted by the University of Wisconsin Center for Cooperatives about ten years ago pegged WCS's production of SoyPLUS® in 1995 to have been* *approximately 145,000 T. This was before the plant was expanded from 600 T/day to 900 T/day. Prorating the 1996 production to reflect the increased capacity would equal production of 217,500 T/year.]*

WCS has a feed mill adjacent to its soybean crush plant in Ralston, but none of its SoyPLUS® soybean meal is used by the feed mill, since the feed mill makes hog and poultry feed, for which it buys conventional soybean meal from other crushers. Rather, SoyPLUS® is sold and shipped to feed mills and dairy operations throughout the country.

According to a University of Minnesota study, SoyPLUS® is 60% RUP. By comparison, conventional hipro soybean meal was 42.6% RUP in the same study.

[NOTE: In 1996 WCS began producing methyl esters (biodiesel) under the Soy Power® brand name. A new, 12 million gallon/year continuous flow biodiesel plant was opened in 2002, capable of processing all of the crush plant's oil production. In 2003 WCS formed the Renewable Energy Group (REG), along with a construction company called Todd & Sargent of Ames IA, to foster the development of the biodiesel industry in USA. REG has since been expanded to include Bunge and Crown Iron Works of Minneapolis. It is a leading producer and marketer of biodiesel. The SoyMor biodiesel plant in Glenville MN is an REG-affiliated plant.]

<u>Grain States Soya, West Point NE</u>
Located in northeast Nebraska. Established in 1958. Uses the same expeller process as WCS to produce HBPSM, marketed under the Soy Best® brand name. Has expanded its capacity over the years by acquiring used expellers as they become available. Current capacity is 270 T/day. Can produce 75,000 T/year of HBPSM if operating at capacity.

The University of Minnesota study found Soy Best® to have 73.3% RUP. Grain States Soya's website makes note of this, stating "new process" Soy Best® has a much higher RUP % than the previous product.

<u>AGP, Mason City IA and Hastings NE</u>
Mason City plant is located in north central Iowa; Hastings plant is located in south central Nebraska. Both plants produce HBPSM by heat treating solvent extracted meal after it has been desolventized, marketed under the brand name AminoPlus®. The Mason City plant is quite old and not very large by current standards for solvent plants, at 1350 T/day. The Hastings plant is newer (started up in 1999) but also not very large, at 2100 T/day. Volume of HBPSM is difficult to determine because most of the production is conventional soybean meal. One industry insider estimates that the two plants together produce 80,000-100,000 T/year.

The University of Minnesota study did not included AminoPlus®. AGP's website claims that AminoPlus® has 72% RUP.

[NOTE: One industry source thinks that AGP is considering adding AminoPlus® production at its crush plant in Sergeant Bluff IA, which is a short distance south of Sioux City. However, AGP apparently does not have any plans to add AminoPlus® production at its crush plant in Dawson MN.]

<u>Cargill, Des Moines IA</u>
Located in central Iowa. Old plant with capacity of 1500 T/day. Like AGP, most production is conventional soybean meal. Produces Soy Pass® HBPSM under contract for Borregaard LignoTech of Rothschild WI, using a process that has been patented by Borregaard LignoTech. The process involves treating conventional soybean meal with a lignosulfonate called xylose and heating it at 215° F for 40 minutes. This imparts a high level of RUP (74.0% in the University of Minnesota study) while leaving intestinal digestibility of the protein almost unchanged from that of conventional soybean meal, 89% versus 90%, according to Borregaard LignoTech.

Land O' Lakes, which is the largest feed company in USA, markets Soy Pass® soybean meal under its own brand name, SurePro®. So Cargill at Des Moines produces Soy Pass® meal under contract for Borregaard LignoTech, who sells it to Land O' Lakes, who uses it in its company-owned feed mills and also sells it to Land O' Lakes affiliated feed mills, under the SurePro® name. Borregaard LignoTech also sell Soy Pass® directly to others in areas where it does not compete with SurePro®.

Cargill is the only contract manufacturer of Soy Pass® for Borregaard LignoTech in USA. It first started doing so at one of its two crush plants in Cedar Rapids IA in the late 1980s (the same plant where Cargill produces soy flour), but soon afterward moved production to the crush plant in Des Moines. Borregaard LignoTech has had discussions in the past with CHS about having Soy Pass® produced at the new CHS crush plant in Fairmont MN, but nothing developed and at this point discussions have ceased.

Borregaard LignoTech was not willing to disclose the volume of Soy Pass® that is produced, but it is not as much as WCS produces at Ralston (SoyPLUS®).

[NOTE: The four brand names of HBPSM are so similar that Borregaard LignoTech felt compelled to state on its website: "Soy Pass is a product of Borregaard LignoTech. SoyPlus is a product of West Central Cooperative, Ralston, Iowa. Soy Best is a product of Grain States Soya, West Point, Nebraska. AminoPlus is a product of Ag Processing, Omaha, Nebraska."]

In addition to the producers of HBPSM, there are a few extruder/expeller plants in the 6-state region that are capable of producing MBPSM:

<u>Midwest Protein, Grove City MN</u>
Located in west central Minnesota, between Litchfield and Willmar. Established in 1995. Fifty-five T/day plant. Focuses primarily on the organic market, which accounts for 60-70% of production.

<u>Northwood Mills, Northwood ND</u>
Located in northeast North Dakota. Three hundred T/day plant that started up this summer. Plans to market meal under brand name E-Meal, the E standing for energy, to play on the high fat content of the meal.

<u>Quality Roasters, Valders WI</u>
Located in east central Wisconsin, near Manitowoc. Established in 2001. Current capacity is only 25 T/day but plans to expand to 150 T/day to be coincide with an expansion by the Renewable Alternatives biodiesel plant in Manitowoc to 3 million gallons/year, since Quality Roasters provides Renewable Alternatives with its feedstock.

In addition to the existing plants, there are three more extruder/expeller plants being planned for South Dakota. On September 19, Natural Gold LLC broke ground for a plant in Aberdeen which the press release (Aberdeen American News, September 19) stated will have capacity to crush 5 million bushels/year. This would make it about a 450 T/day plant. The company plans to produce a biodiesel product called Dakota Ag Additive. The same news item stated that Coteau Hills Processors is planning to build a 6 million bushel/year plant in Webster, which is about 50 miles east of Aberdeen in northeast South Dakota, and South Dakota Oilseed Processors is planning to build a 375 T/day plant at Miller, which is between Huron and Pierre in central South Dakota.

[NOTE: North Dakota Mills, Coteau Hills Processors and South Dakota Oilseed Processors plan to employ supercritical CO_2 technology, once it becomes commercially feasible, to produce a type of soy protein for human consumption.]

Consumption of HBPSM

If HBPSM simply displaced conventional soybean meal in dairy rations, there would be no net gain in soybean meal consumption by increasing its use. However, when used properly, HBPSM does not displace conventional soybean meal, but fills a different need in the ration of a high producing dairy cow. Quoting from an article published in Manitoba Agriculture in November, 2005: *"Approximately $^{2}/_{3}$ of the amino acids which are absorbed in the small intestine of a cow are synthesized in the rumen by rumen microbes. Microbial protein is one of the highest quality proteins available. The remaining amino acids are provided by the feed, which 'escapes' from the rumen and arrives, intact, in the small intestine. The combination of microbial amino acids and amino acids from the undegraded feed does not provide enough of the amino acids needed by high producing dairy cows. Increasing the amount of undegradable protein in the diet will increase the amount of amino acids available for absorption in the small intestine. This should improve milk production."*

So the role of HBPSM is to provide additional amino acids for absorption in the small intestine. For this place in a dairy ration, HBPSM competes with other high bypass feed ingredients, such as blood meal, fish meal and porcine meat & bone meal. Since conventional soybean meal has only about 40% RUP, it is not suitable for providing the "extra" amino acids to the small intestine, since too much of it would be degraded in the rumen.

According to the University of Minnesota study, blood meal was 95.5% protein (77.5% of which RUP), fish meal was 68.5% protein (65.8% of which is RUP) and porcine meat & bone meal was 54.2% protein (58.0% of which is RUP). While all of these ingredients are high in total protein and RUP, their prices can make them uncompetitive with HBPSM. For example, in mid September 60% protein fish meal was quoted at $855/T at the Gulf Coast. On September 20, conventional hipro soybean meal was being offered at about $265/T f.o.b. Minnesota crush plants. Land O' Lakes was offering SurePro® at $307/T f.o.b. Des Moines. Also, dairy nutritionists formulate for specific amino acids, not crude protein content.

According to a dairy nutritionist at the University of Minnesota, if a dairy ration is high in alfalfa (which has 17-20% protein, but only 18-20% RUP), the ration might include very little conventional soybean meal (perhaps as little as 1 pound/cow/day) and as much 4 pounds/cow/day of HBPSM (or competing high bypass protein ingredient). If the ration is high in corn silage (which has only 8-10% protein, but 30-40% RUP), it might contain 4 pounds/cow/day (or even more) of conventional soybean meal as well as 4 pounds/cow/day of HBPSM (or competing high bypass protein ingredient).

These levels of consumption of HBPSM were confirmed by a dairy nutritionist at the University of Wisconsin and by the manager of a large feed company in the dairy region of south central Wisconsin. They also thought that the USDA/NASS report stating that 22% of dairy operations use HBPSM is accurate, if not a little understated. Also, 22% of dairy operations using HBPSM is not the same as 22% of dairy cows being fed HBPSM, since not all dairy operations are the same size, and the larger ones would be more inclined to use HBPSM. The University of Wisconsin Center for Cooperatives study mentioned above found that "80% of [feed] dealers surveyed carry a soy meal product with high bypass protein" and "…dealers indicated that, on average, about one-third of their customers are currently using these products."

If one assumes that 30% of dairy cows are consuming HBPSM at an average rate of 2 pounds/cow/day, consumption of HBPSM in the six states of the Upper Midwest would be as follows:

- Minnesota – 450,000 head x 30% x 2 pounds/cow/day = 49,000 T/year
- Wisconsin – 1,243,000 head x 30% x 2 pounds/cow/day = 136,000 T/year
- Iowa – 205,000 head x 30% x 2 pounds/cow/day = 22,000 T/year
- South Dakota – 81,000 head x 30% x 2 pounds/cow/day = 9,000 T/year
- Nebraska – 61,000 head x 30% x 2 pounds/cow/day = 7,000 T/year
- North Dakota – 32,000 head x 30% x 2 pounds/cow/day = 4,000 T/year
  6-state total – 2,072,000 x 30% x 2 pounds/cow/day = 227,000 T/year

However, this is only a "guesstimate." Thirty percent of dairy cows being fed HBPSM is only an estimate, and feeding rates can vary considerably depending on competitiveness with other high bypass proteins. If the feeding rate were 3 pounds/cow/day rather than 2 pounds/cow/day, consumption in the 6-state region would be half again as much, or 341,000 T/year. And if 35% of dairy cows (rather than 30%) were consuming 3 pounds/day of HBPSM, the figure would jump to 397,000 T/year. The lower figure of 220,000 T/year is considered a "safe" estimate, while an upper figure of 397,000 T/year is probably optimistic. The actual figure is probably somewhere in the middle, around 300,000 T/year, but widely variable around that figure.

Two of the producers of HBPSM mentioned previously, West Central Soy in Ralston IA and Grain States Soya in West Point NE can produce 325,000 T/year of HBPSM between them. This is enough to satisfy most, if not all, of current estimated consumption of HBPSM in the 6-state Upper Midwest region. Adding another estimated 200,000 T/year among the two AGP plants and Cargill's plant at Des Moines, and total estimated HBPSM production in the Upper Midwest comes to 525,000 T/year. One producer of HBPSM estimates that there are 500,000 T of HBPSM produced annually among the four producers (five plants) in the Upper Midwest, ±50,000 T/year.

Although estimated production of up to 550,000 T/year of HBPSM in the Upper Midwest seems like an oversupply situation compared with 227,000 to 397,000 T/year of consumption in the region, a lot of HBPSM produced in the region is shipped out of it. In fact, WCS claims to ship SoyPLUS® to nearly every state in the country. A lot of this goes to five large dairy states in the West. California, the #1 dairy state, with 43% more dairy cows than #2 Wisconsin, could consume 195,000-341,000 T/year of HBPSM (again using the variables of 30% or 35% of dairy cows consuming it, at rates of 2 or 3 pounds/cow/day). Another large western dairy state, #5 Idaho, with 8% more dairy cows than #6 Minnesota, could consume 53,000-93,000 T/year. Colorado, Oregon and Washington have 465,000 dairy cattle among them, or about the same number as Minnesota. That equals another 50,000-88,000 T/year of HBPSM consumption. Most of the consumption of HBPSM in these Western states would come from the plants in the Upper Midwest. *[NOTE: The top ten dairy states as of December 1, 2006 were California, Wisconsin, New York, Pennsylvania, Idaho, Minnesota, New Mexico, Texas, Michigan and Ohio. They accounted 71% of the USA dairy herd.]*

Summarizing, the producers of HBPSM in the Upper Midwest can produce 550,000 T/year while consumption of HBPSM in the Upper Midwest and the five western states mentioned above (California, Colorado, Idaho, Oregon and Washington) is in the range of 520,000 to 910,000 T/year. Therefore, supply of and demand for HBPSM appear to be in fairly good balance , with the supply situation being tight when HBPSM is price-competitive with other high bypass proteins and feeding rates are higher.

Of course the market for HBPSM would be much larger if more than 30-35% of dairy operations used it. Those interviewed for this study said that usage of HBPSM has increased over the past few years as consolidation in the dairy industry has created larger, more sophisticated operations. One large user, who has seen increased usage in recent years, stated that "better managers are using it and better consultants are recommending it." So there certainly appears to be a lot of upside potential for HBPSM.

Cost-benefit of feeding HBPSM

The University of Minnesota has not conducted any milk production studies on bypass protein in the past decade.

AGP has a cost-benefit table on its website, which is reproduced in Table 2 on the next page.

Table 2
Cost-Benefit of Feeding AminoPlus® HBPSM
Source: AGP website

Feed AMINOPLUS® for Increased Profitability

- Feed AMINOPLUS® at a rate of 2 to 3 pounds per head per day.
- The cost of replacing soybean meal is 3-4 cents per day.
- Research trials show a milk production increase of up to 10% vs. non-RUP control.

Turn Pounds into Dollars with AMINOPLUS®

Increased Profitability, $/100 Cows/Day*

	Milk, $/cwt		
Response, %	10	12	14
4 (2.8 lbs)	$24.00	$29.60	$35.20
6 (4.2 lbs)	$38.00	$46.40	$54.80
8 (5.6 lbs)	$52.00	$63.20	$74.40

*Estimates based on 70 pounds of milk per cow per day and 4-cent daily cost to add AMINOPLUS® to ration.

The table is out of date regarding the price of milk, which is about $20/cwt today. However, the statement "4-cent daily cost to add AminoPlus® to the ration" at the bottom of the table clearly is based on *replacing* conventional soybean meal with AminoPlus®, rather than using it in addition to conventional soybean meal. Feeding 2-3 pounds/day (first bullet point in the table) at a cost of only 4 cents/day translates into a cost of only 1.33 to 2 cents/pound of AminoPlus®, or $27 to $40/T. This would be the cost difference between AminoPlus® and conventional soybean meal. The second bullet point also states that the analysis is based on replacement of conventional soybean meal in the ration.

Therefore, the increased profitability shown in Table 2 is not reflective of the situation in which a dairy ration includes HBPSM as a source of bypass protein in addition to whatever conventional soybean meal is included in the ration. If it were, it would look as follows, based on $20/cwt milk and HBPSM at $300/T (= $0.15/pound):

- Cost to feed 3 pounds of HBPSM/cow/day = $0.45/cow/day = $45/hundred cows/day
- Value of increased milk production at $20/cwt milk price and a baseline of 70 pounds of milk/cow/day
    - 4% increased milk production = 2.8 pounds/cow/day = $0.56/cow/day = $56/hundred cows/day
    - 6% increased milk production = 4.2 pounds/cow/day = $0.84/cow/day = $84/hundered cows/day
    - 8% increased milk production = 5.6 pounds/cow/day = $1.12/cow/day = $112/hundered cows/day

- Net increased profitability
    - 4% increased milk production = $11/hundred cows/day
    - 6% increased milk production = $39/hundred cows/day
    - 8% increased milk production = $67/hundred cows/day

Land O' Lakes's SurePro® website shows field test results with milk production increasing 3.2 pounds/cow/day (from 98.5 pounds to 101.7 pounds, which probably are more typical for high producing dairy cows than 70 pounds/cow/day). Using the same assumptions as above, this would result in net increased profitability of $17/hundred cows/day.

[NOTE: $300/T is a historically high price for HBPSM, because conventional soybean meal also is currently at a historically high price. The historical price for HBPSM is in the range of $225 to $250/T.]

Impediments to increasing use of HBPSM

Regardless of the accuracy of the cost-benefit analysis shown here, it is clear that a large number of dairy operations are convinced that feeding HBPSM increases their profitability. Otherwise it wouldn't be such a well-established practice over many years, and one that appears to be growing in popularity. So why isn't it done my more than about a third of dairy operations? Several factors come into play:

- *Cost*. Some dairy operations will always pursue a least-cost feeding program, regardless of cost-benefit analyses. Also, at times other high bypass protein ingredients (blood meal, fish meal, porcine meat & bone meal, etc.) might be more price competitive than HBPSM.
- *Unavailability*. HBPSM is a specialty ingredient produced only at a handful of soy crush plants in the Upper Midwest. This means that the product isn't always available.
- *Lack of education about and/or adequate promotion of the product*. Producers of HBPSM have done a lot of promotion of their product, but there always will be those who don't get the word.
- *High transportation costs* from producers in Iowa and Nebraska to dairy operations in Minnesota and Wisconsin. This is an increasing impediment as transportation costs increase. In conducting a previous study, the author of this study was told by some dairy operations in west central Minnesota that they no longer used HBPSM due to it costing too much to get it delivered from central Iowa, but that they would consider using it again if there were a local supplier.
- *Inconsistent % of RUP*. Underheating/toasting or uneven heating/toasting is usually the reason for this.
- *Inconsistent % of intestinal absorbable protein*. Overtoasted HBPSM may bypass the rumen fine, but if the protein is not absorbable in the small intestine, nothing is gained, and more waste is produced. A product that is 80% RUP but only 50% absorbable in the small intestine makes only 40% of the protein available post-rumen, whereas one that is 60% RUP and 80% absorbable in the small intestine makes 48% of the protein available post-rumen.
- *Increased feeding of ethanol co-products*. DDG has about 50% RUP and is notoriously inconsistent in both RUP and intestinal absorbable protein. However, there is a lot of it available today at very competitive prices, so dairy operations use a lot of it. In the USDA/NASS study on use of ethanol co-products released in June, 45% of dairy operations surveyed said that they use DDG (distillers dried grains with no solubles and 22% said that they use DDGS (distillers dried grains with solubles). The former figure is twice the number that said they used HBPSM and the latter figure is the same. *[NOTE: This does not mean that 67% of dairy operations use DDG or DDGS, since many could use both.]*
- *Feeding of roasted soybeans*. These often are considered to have high bypass protein, but the University of Minnesota study found them to be only 39.4% RUP, compared with 30.4% for raw soybeans. As with all products that get their bypass quality by heating, inconsistency of RUP intestinal digestibility are concerns. Also, the fat content of whole soybeans is 18-19%, which is higher than recommended for a dairy cow. But it still is a very common practice. Indeed, the USDA/NASS study found that 31% of dairy operations surveyed feed roasted soybeans (see Table 1).

Outlook

Feeding of HBPSM is increasing as dairy operations become larger and more sophisticated. Both producers and users of HBPSM confirm this trend, which is likely to continue.

There are two large concentrations of dairy cattle in Minnesota: one in the area between St. Cloud and Fergus Falls in central and west central Minnesota, and the other in the extreme southeast corner of the state, as depicted in Map 1.

Map 1
Dairy Cows in Minnesota on January 1, 2006
Source: USDA/NASS 2006 Minnesota Agricultural Statistics

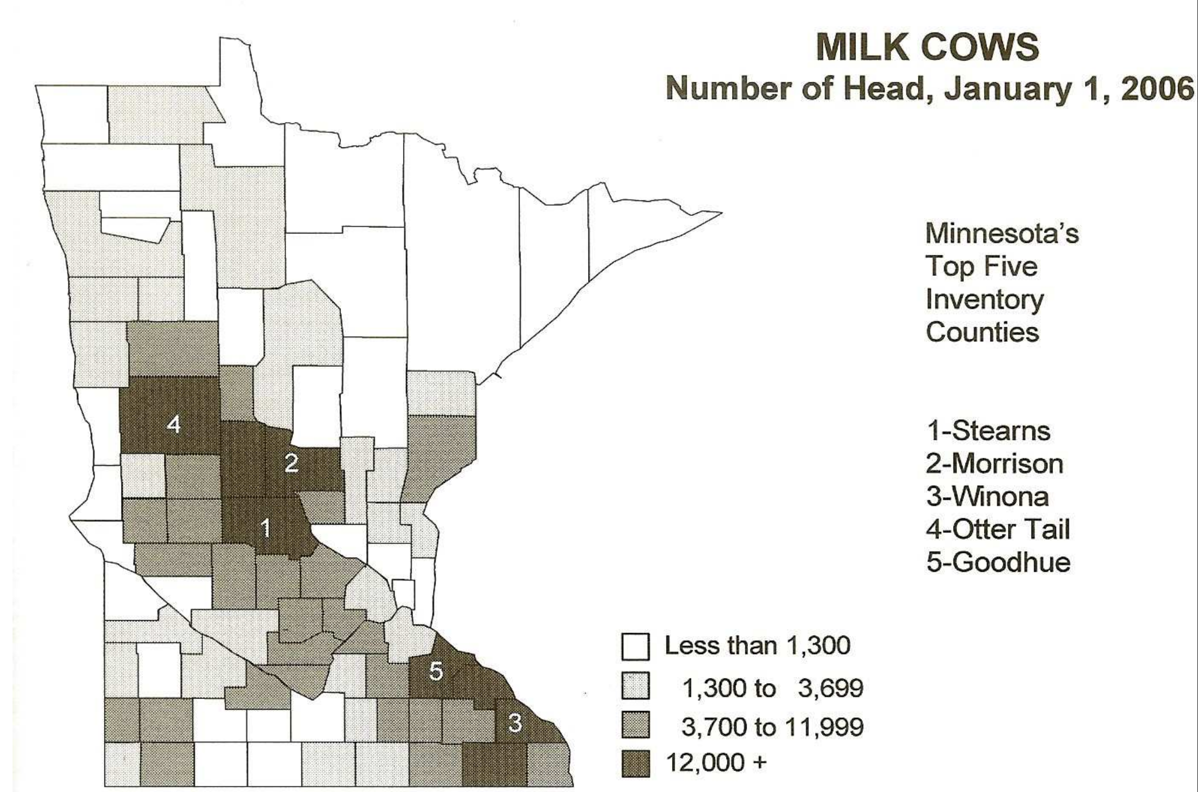


Table 3 shows the distance from the approximate center of the top five dairy counties in Minnesota to the three producers of HBPSM in Iowa and to Grain States Soya in West Point NE (AGP at Hastings is more remote yet).

Table 3
Distance from Top Five Minnesota Dairy Counties to Producers of HBPSM
Source: Google® Maps

	Distance in Miles			
County/City	Mason City IA	Des Moines IA	Ralston IA	West Point NE
Stearns/Albany	223	328	353	359
Morrison/Pierz	239	344	369	404
Winona/Witoka	145	250	276	374
Otter Tail/Ottertail	324	428	454	411
Goodhue/Hader	118	223	249	347

Table 3 shows that Mason City, in north central Iowa, is the nearest producer of HBPSM to all five counties, with Des Moines being the second nearest (except for Otter Tail County), being about 100 miles more remote than Mason City, and Ralston being about 125 miles more remote.

A producer of HBPSM located along I-94 between Sterns and Otter Tail Counties would be about 250 miles from Mason City. It would have a freight advantage of $16/T over Mason City to points to which it is 200 miles nearer than Mason City, using a freight cost of $2/loaded mile for a 25 T load of HBPSM, and a freight advantage of $20/T to points to which it is 250 miles nearer than Mason City.

There are approximately 190,000 dairy cows in Minnesota's Northwest Agricultural Statistics District, North Central District, and northern halves of the West Central and Central Districts, which would be the primary market for a producer of HBPSM located along I-94 between Sterns and Otter Tail Counties. Using the same assumptions that were used previously of 30% of dairy cows being fed a ration with 2 pounds/cow/day of HBPSM, consumption would be 21,000 T/year. If the feeding rate were 3 pounds/cow/day, consumption would increase to 32,000 T/year.

This is the same figure (32,000 T) that was used in a feasibility study for a proposed expeller plant in the Otter Tail area that was conducted in early 2006. If the plant made only HBPSM, it would require a capacity of only 125 T/day. That is quite a small expeller plant to be economically viable. The feasibility study suggested that the plant be 200 T/day, with the remaining production being high fat (but not high bypass) meal, to the extent that enough HBPSM could not be sold. This project currently has been suspended, if not abandoned altogether.

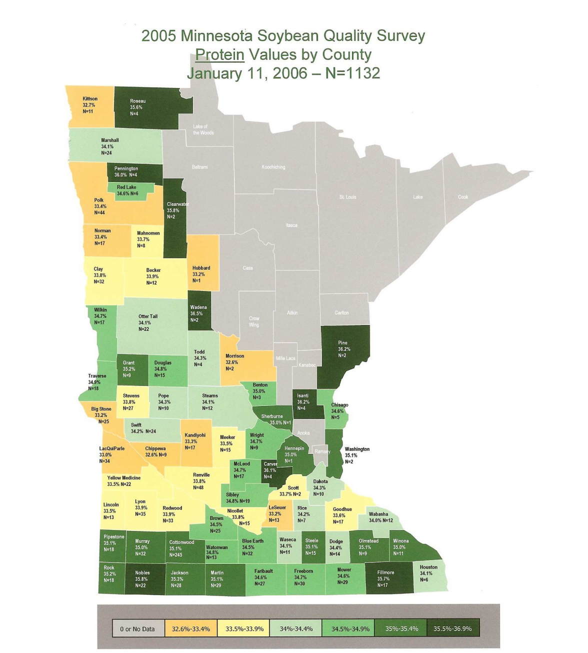
A producer of HBPSM located near Rochester on either Highway 52 or I-90 would be midway between Winona and Goodhue Counties and 100-150 miles nearer points in the southeast Minnesota dairy area than Mason City. It would have a freight advantage of $8-12/T.

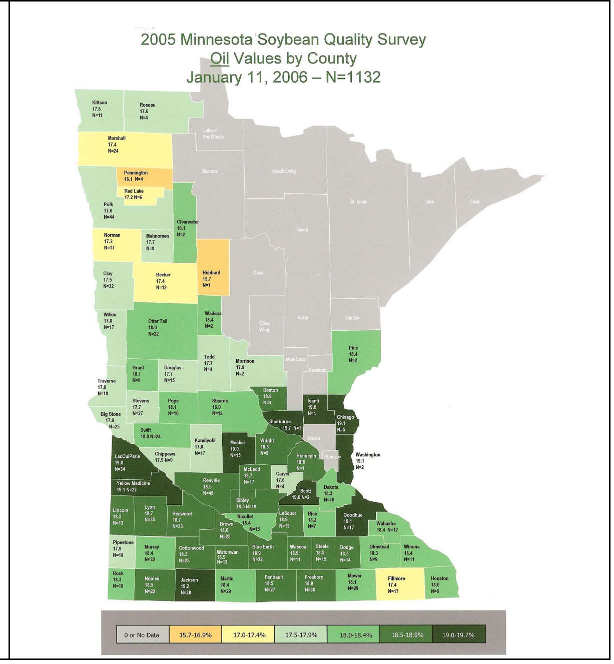
There are approximately 107,000 dairy cows in Minnesota's Southeast Agricultural Statistics District. In addition, there are approximately 419,000 dairy cows in Wisconsin's Northwest, North Central and West Central Agricultural Statistics Districts, which includes Wisconsin's #1 and #2 dairy counties, Marathon and Clark, in the central part of the state. These 526,000 cows could consume 58,000 to 86,000 T/year of HBPSM. The higher figure would require a plant with crush capacity of 300 T/day, which is a reasonable size for an expeller plant.

A study conducted for AURI in the fall of 2000, updated in the fall of 2005, entitled "Opportunities to Add Value to Oilseeds and Oilseed Products in Minnesota" concluded that construction of a soybean "mini-mill" (i.e. expeller plant) was worthy of further study. The 2000 study specifically mentioned the southeast location as promising. The 2005 study focused more on the west central location. However, the southeast location has three factors in its favor over the west central location:

1. Larger potential market for HBPSM, due to its proximity to Wisconsin, so a larger plant could be built and thereby achieve greater economies of scale.
2. Closer to more "stand alone" biodiesel plants, which will be scrambling to secure enough soybean oil feedstock.
3. Better quality soybeans to crush, since soybeans grown in the southeast section of the state generally have higher protein and oil content than those grown in the west central section. Map 2 on the next page shows this graphically. *[NOTE: The data depicted in Map 2 are from the 2005 soybean crop. The survey conducted with the 2006 crop did not have enough samples to produce valid results. However, the phenomenon of soybean protein and oil content declining the farther north the soybeans are grown has been known for many years and is repeatable year after year.]*

Map 2
2005 Minnesota Soybean Quality Survey—Protein & Oil Value
Source: University of Minnesota





The key at the bottom of each map shows lower content on the left (tan) to higher content on the right (dark green). Map 2 clearly shows that both protein and oil content decline going from south to north. *[NOTE: The few exceptions in the northwest are due to only 2-4 samples being obtained from those counties. There were 20 or more samples obtained from most counties in the south.]*

A case could be made for pursuing an expeller plant with capacity of around 300 T/day in the southeast corner of Minnesota. While this may be beneficial to the local soybean industry, this will address the "bigger picture" of needing to process more soybeans to provide more soybean oil to the emerging biodiesel industry only if it increases the use of HBPSM, rather than just displacing HBPSM that is currently coming into the area from Iowa. In other words, the size of the pie has to grow, not just a reallocation of the pieces of the pie.

There is reason to believe that increased consumption of HBPSM would happen if there were a nearer supplier. Although any point in the target market area would be only 100 miles nearer to a plant in, for example, the Rochester area, than to the AGP plant in Mason City, the distance widens out to 210 miles when compared with Des Moines, and to 235 miles when compared with Ralston. Due to the three different methods used by AGP, Cargill and WCS to impart the bypass feature, some dairy operations have a preference for one over the other, even if the freight cost is greater to obtain the preferred HBPSM.

A first step in pursuing an expeller plant is southeast Minnesota might be to conduct a thorough survey of dairy operations in southeast Minnesota and the northwest quadrant of Wisconsin, to determine how much HBPSM is being consumed in the area, where it is coming from, and how much additional HBPSM might be consumed in the area if there were a nearer supplier.

Another possibility would be for one of the existing soybean crush plants to add the capability to produce HBPSM. But none has, even though they are aware of the product and have been faced with a great oversupply of conventional soybean meal in Minnesota since the start-ups of the plants at Brewster and Fairmont nearly four years ago. If any of them saw adding HBPSM production capacity as a means to address this oversupply situation, one would think that they would have done so by now.

Conclusion

With the advent of biodiesel, demand for vegetable oil during the next decade is likely to increase even more rapidly it did during the past decade, when worldwide consumption of oils and fats increased by 66% while worldwide population increased by only 15%.

Soybeans have been the predominant oilseed in USA for many years, accounting for 90% of total oilseed production in 2006, with soybean oil accounting for 55% of total oils and fats production and 78% of total vegetable oil production. Therefore, it is logical that biodiesel industry in USA has been predominantly soybean oil-based.

However, the vast majority of soybean oil already is being consumed by the domestic food industry. In the year that ended September 30, 2007, 7% of USA soybean oil production was exported, 10% was consumed by the biodiesel industry, and 83% was consumed by the domestic food industry. Yet the amount of biodiesel production capacity that is already operating or under construction that plans to use soybean oil as its primary feedstock would require half of current soybean oil production. Even if all the soybean oil that is currently being exported were retained in the domestic market, it would fall far short of providing the amount of feedstock needed by the biodiesel industry, assuming there will be enough demand for biodiesel to allow the industry to operate at near capacity.

Therefore, more soybean oil is going to be needed. The soybean crushing industry has responded to "signals" from the market and a lot of new capacity will be coming on line during the next year, the first significant expansion of the industry since the CHS and Minnesota Soybean Processors plants at Fairmont and Brewster started up in the fall of 2003.

But when soybean oil is produced, so is soybean meal, and finding homes for large additional soybean meal production will be challenging. Domestic consumption is growing slowly and high priced corn and soybean meal are cutting into profits of the livestock and poultry industries, discouraging expansion. Argentina has become the primary soybean meal supplier to world markets. Some market observers believe that soybean meal will be priced at "marketing clearing" prices to buy its way back into the export market and increase domestic consumption by making the livestock and poultry industries more profitable. Time will tell if this scenario plays out, but today soybean meal is priced closer to its historical highs than to its lows.

Soy flour and HBPSM are alternative products to conventional soybean meal. Expansion of the use of either would contribute toward the need to find more homes for the meal side of the equation. Both products have been around for many years and neither seems to be poised for rapid expansion. Also, they account for a very small portion of meal consumption−no more than 5% combined. So even if use of each product doubled for some unforeseen reason, it would make only a small contribution to what is needed in meal consumption, if the crushing industry is going to expand greatly to provide feedstock for the biodiesel industry.

A 300 T/day expeller plant in southeast Minnesota producing HBPSM to serve the dairy industry in that corner of the state and in the northwest quadrant of Wisconsin and producing soybean oil to serve stand-alone biodiesel plants in Minnesota and Wisconsin might be economically viable. Dairy operators in the region are currently obtaining their HBPSM from crush plants in Iowa and Nebraska.

A logical start would be to conduct a thorough survey of dairy operators in the region to determine how much HBPSM they are using, where it is coming from and how much more would be consumed in the region if there were a nearer supplier. While such a plant might be profitable, it wouldn't produce much soybean oil−only enough to produce about 4 MG/Y of biodiesel.

Appendix

People contacted in preparing this study

Name	Organization	Expertise	Telephone/e-mail
Ash, Mark	USDA/ERS Washington DC	Oilseed statistics	202-694-5289 mash@ers-usda.gov
Baize, John	John C. Baize & Associates Falls Church VA	Soybean industry statistics	703-698-0321 jbaize@att.biz
Busse, Shelly	USDA/NASS Washington DC	Agricultural statistics	800-727-9540 nass@nass.usda.gov
Golbitz, Peter	Soyatech Bar Harbor ME	Soybean industry statistics	207-288-4969 (ext 101) peter@soyatech.com
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Harris, Brian	Global Risk Management St Louis MO	Commodities trading	636-485-6697 bharris@grmgroup.com
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Hoefs, Kent	Borregaard LignoTech Sioux Falls SD	Producer of Soy Pass meal	605-360-6670 kent.hoefs@borregaard.com
Larson, Gordon	Midwest Protein Grove City MN	Mid bypass meal producer	320-857-2829
Linn, Jim	University of Minnesota Minneapolis MN	Dairy nutrition	612-624-1205 linnxoo2@umn.edu
McCarthy, Krista	Environ Biocomposites Mankato MN	Composite manufacturer	507-388-3434 sales@environbiocomposites.com
McKenzie, Terra	ADM Decatur IL	Soy flour	800-637-5843 mckenzie@admworld.com
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Schubbe, Pam	CHS Mankato MN	Soy flour	507-625-7911 Pam.Schubbe@chsinc.com
Shaver, Randy	University of Wisconsin Madison WI	Dairy nutrition	Not available rdshaver@facstaff.wisc.edu
Shurson, Jerry	University of Minnesota Minneapolis MN	Swine nutrition	612-624-2764 shurs001@umn.edu
Stauffer, Clyde	Technical Food Consultants Cincinnati OH	Soy flour	513-931-2632

Qualifications of Robert W. Carlson

Robert W. Carlson has been engaged in the oilseed processing industry since 1972. Experience includes:

Selected Consulting Projects

- "Feasibility Study for Soybean Processing Plant in Southern Wisconsin"
  - Completed: August 2006
  - Client: Wisconsin Soybean Board
  - Contact: Bob Karls, karls@wisoybean.org, 608-274-3988

- "Feasibility Study for Expeller Soybean Processing Plant in West Central Minnesota"
  - Completed: March 2006
  - Client: Central Minnesota Soybean Processors
  - Contact: Terry Wagenman, twagenman@rdoffutt.com, 218-298-0355

- "Update of Opportunities for Value-added Utilization of Oilseeds and Oilseed Products in Minnesota"
  - Completed: October 2005
  - Client: Agricultural Utilization Research Institute, Marshall MN, USA and Minnesota Soybean Growers Association
  - Contact: Max Norris, 507-537-7440, mnorris@auri.org; Jim Palmer, 507-388-1635, jim@mnsoybean.com

- "Feasibility Study for Soybean Oil Processing, Refining and Esterification (SOPREP) Plant in Michigan"
  - Completed: May 2001
  - Client: Zeeland Farm Service, Zeeland MI, USA and Michigan Soybean Association
  - Contact: Cliff Meeuwsen, 616-772-9042, cliffm@zfsinc.com; Keith Reinholt, 517-652-3294, reinholt@michigansoybean.org

- "Opportunities for Value-added Utilization of Oilseeds and Oilseed Products in Minnesota"
  - Completed: September 2000
  - Client: Agricultural Utilization Research Institute, Marshall MN, USA and Minnesota Soybean Growers Association
  - Contact: Max Norris, 507-537-7440, mnorris@auri.org; Jim Palmer, 507-388-1635, jim@mnsoybean.com

- "Feasibility Study for Missouri Value Processors"
  - Completed: April 2000
  - Client: Missouri Value Processors, Chillicothe MO, USA and Missouri Soybean Association
  - Contact: Dale Ludwig, 507-537-7440, dludwig@mosoy.org

- "Feasibility Study for Specialty Oilseed Processing Plant in North Dakota"
  - Completed: April 1997
  - Client: Security State Bank of North Dakota and AgGrow Oils, Carrington ND, USA
  - Contact: John Gardner, GardnerJ@missouri.edu

- “Feasibility for Sunflower Processing Plant in South Dakota”
    - Completed: December 1996
    - Client: Farmland Industries, Kansas City MO, USA
    - Contact: No longer available

Employment History within the Oilseed Processing Industry

- February 2005—present: Independent agribusiness consultant, Minneapolis MN, USA
- April 2004–January 2005: General Manager, Cargill Trading Egypt, Cairo, Egypt; Managing Director, National Vegetable Oil Company, Borg el-Arab, Egypt; Soybean processing plant
- November 2003–February 2004: Chief Executive Officer, Farmers Oilseed Cooperative, Claxton GA, USA; Proposed specialty soybean and canola processing plant
- October 2002–October 2003: Independent agribusiness consultant, Minneapolis MN, USA
- September 2001–August 2002: General Manger, Crown Friendship Engineering Company, Wuhan, China; Designer and manufacturer of oilseed processing and refining equipment
- November 1999–August 2001: Independent agribusiness consultant, Minneapolis MN, USA
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- July 1997–October 1999: Managing Director, Champion Food & Oils Group, Cairo, Egypt; Soybean, sunflower and cottonseed processing and refining
- March 1996–June 1997: Independent agribusiness consultant, Minneapolis MN, USA
- November 1993–February 1996: Vice President-Operations, National Sun Industries, Minneapolis MN, USA; Oilseed processing plants in North Dakota (sunflower, canola and crambe) and Kansas (soybean and sunflower)
- May 1972–January 1991: General Manager, Cargill Inc, Minneapolis MN, USA; Oilseed processing plants in Minnesota (soybean), Iowa (soybean) and North Dakota (sunflower and flaxseed)