

What Soybean Processors Don't Tell Us

Hexane, a dangerous solvent, is used to process soybeans

by Paris Reidhead

Soybeans are the world's largest source of vegetable protein for both humans and animals. The most common method of removing the soybean's oil from its protein fraction involves the use of a chemical that has been proven to be toxic to lab animals and humans.

This liquid solvent, hexane, has been red-flagged as a carcinogen by the American Cancer Society.

Since 1972, hexane has been the backbone of the U.S. soybean processing industry. This cancer-causing solvent is used in more than 95% of soybeans processed into oil and meal in the U.S.

Soybean milling processes haven't changed much over the years. The equipment has become significantly larger and highly computerized, but three basic mechanical methods remain for removing oil from soybeans, and other oil-rich seeds for that matter. (The raw, ripe, soybean contains 15-20% of its weight as oil.) These methods are referred to as the hydraulic process, the expeller process, and the solvent process.

The hydraulic process crushes the whole soy seed into flakes, and then thoroughly cooks the mass by steam. The resulting mass is formed into cakes, which are then placed in hydraulic presses where enormous pressure is applied to squeeze out as much oil as possible. The oil-free residue, in the form of hard cakes or slabs, is then ground into meal. Today, the hydraulic process is rarely used.

In the expeller process, the seeds are cracked, dried, and then heated in a steam-jacketed apparatus. The oil is separated by expellers, or screw presses, where enormous pressure is exerted by a worm shaft revolving in a horizontal barrel. Considerable heat is produced by the friction as the material passes through the expeller under such great pressure. The friction cooks the meal thoroughly. In soybeans, the heating process eliminates the trypsin inhibitor factor, which is detrimental to protein digestion, particularly for non-ruminants. The oil-free residue, which is in flake form, is ground into meal or may be pelletized.

In the solvent process, the seed is cracked, heated mildly, and rolled into thin flakes. The flakes then pass into an extracting tower, where the oil is chemically removed by a volatile solvent. The residue is then heated and dried to remove all traces of the solvent.

The solvent process removes the oil more completely than do the hydraulic and expeller processes. The first two processes may leave up to five percent oil in the soybean meal, while the solvent process may remove all but 1% (or less) of the oil. The less oil remaining in the meal, the higher its protein level for animal feed purposes. Expeller- and hydraulically-processed soybean meal are about 44% protein, while the solvent method soybean meal runs about 50% protein.

In processing soybeans by the solvent method, the extracted soybean flakes are heated a second time in a treatment referred to as "toasting," again in a steam-jacketed apparatus. The toasting cooks the flakes enough to produce satisfactory feeding results for swine and poultry. After the toasting, the flakes are ground into soybean meal, or they may be pelletized.

For every ton of crude soybean oil extracted, 2.5 tons of solvent must be removed by distillation. The distillation allows the recapture of most of the solvent, which is re-used.

Hexane: highly flammable neurotoxin

The organic (that is, carbon-based) solvent of choice for processing soybeans is iso-hexane. It differs in chemical structure (though not element package) from the classic hexane, which consists of six

carbons and fourteen hydrogens, and has been used for decades in this process.

Organic farming regulations prohibit the use of hexane. There are two reasons for this restriction: one, hexane (or any other similar solvent) is a synthetic product, and thus prohibited by national organic standards; two, there is a possibility, however slight, that some organic solvent residue may remain in the soybean meal.

I did some research into chemical and medical traits of hexane. Here's what I found. Hexane's Department of Transportation label lists it as flammable. Hexane's C₆H₁₄ formula give this chemical a molecular weight of 86.1. Hexane boils at 156 degrees F, and freezes at -139F. The National Fire Protection Association (NFPA) assigned hexane a flammability rating of 3, meaning that it is a severe fire hazard.

The National Institute of Occupational Safety and Health (NIOSH) has established a recommended exposure limit for hexane of 50 ppm for a 10-hour work day or 40-hour work week. In a fire involving hexane, NFPA recommends the affected area be isolated with a half-mile radius cordon, and that unmanned hose-holders be used to apply water.

Quoting the NFPA directive, "Vapors may travel to a source of ignition and flash back. Vapors are an explosion and poison hazard indoors, outdoors, or in sewers. Containers of hexane may explode in the heat of the fire, and should be moved from the fire area, if it is possible to do so safely."

Hexane's toxicity to the human nervous system is well documented.

According to the Occupational Safety and Health Administration, hexane is a neurotoxin, a narcotic, and an irritant to eyes, skin, and mucous membranes. Hexane also causes embryotoxic effects and is cytotoxic (poisonous at cellular levels) in mammalian and human test systems.

Mice exposed to concentrations of 1000-2000 ppm for 24 hours/day for six days/week for one year have developed atrophy and degeneration of hind leg muscle fibers. Mice exposed to hexane at 2500-3000 ppm for four days have developed liver enlargement within 24 hours of exposure onset. Offspring of rats and mice exposed orally or by inhalation to hexane during gestation showed depressed weight after birth. Hexane also harms reproductive capacity of both genders.

With humans, hexane is both a narcotic agent and an irritant to eyes, the upper respiratory tract, and skin. Hexane is also a neurotoxin. Exposing humans to 5000 ppm for ten minutes brings about marked vertigo. Exposure to 1500 ppm causes headaches and light nausea. Eye and upper respiratory tract irritation has occurred in humans exposed to 880 ppm for 15 minutes. With respect to skin contact, human subjects developed blisters within five minutes following exposure to hexane.

Hexane's toxicity to the human nervous system is well documented. Polyneuropathy has occurred in humans chronically exposed to hexane levels in the 400-600 ppm range. Polyneuropathy is a neurological disorder occurring when many peripheral nerves malfunction at the same time. Nerve biopsies in affected individuals show swelling of the nerves and thinning of the myelin sheaths (which line the nerves). In fact, quoting Hathaway et al (1991 research): "Functional neurological disturbances usually progress for a few months after termination of exposure." With chronic exposure, clinical symptoms include muscle atrophy, reduced muscle strength, numbness, and tingling sensation in the arms and legs.

Very little research has been done on any carcinogenic (cancer-causing) traits of hexane. However, in a 2004 American Cancer Society publication, "Cancer Prevention and Diet," John G. Conner wrote that it is best to "avoid processed soy foods (grits,

protein, and oil), which have been processed using hexane, a toxic chemical used frequently as an extraction agent." Remember: hexane is used to separate over 95% of all soybeans refined into oil and meal in the U.S.

All told, hexane has a checkered profile. So I wanted to find out what procedures were followed by soybean processors to make sure all the hexane residue is removed from both the extracted oil and the by-product meal.

No answers from ADM

Knowing that the Archer, Daniels Midland is the largest soybean processor and grain commodity marketer in the world, I researched their computer web page. In mid-August, I called ADM's home office in Decatur, Illinois. I wanted to ask three questions: 1) What solvent does ADM use in processing soybeans? 2) What procedure do they use to remove all the solvent from both the soybean oil and the soybean meal? 3) What tests are performed (and by whom) to verify that solvent residues have been reduced to acceptable levels in both oil and meal?

ADM's switchboard sent me to the office of Carla Miller, ADM's chief of public relations. I got to talk to Miller's assistant, Angela Shaw. I posed my questions to Shaw, who said she would give them to her boss, who would return my call immediately. After three attempts to reach her, as of early October I still awaited Miller's call.

Frustrated with ADM, I contacted AgPro, a soybean processor in Massena, New York. I knew AgPro processes some organic soybean meal, but that the vast majority of their work was with conventional soybeans. Daniel McDonald, AgPro's processing manager, told me that the company does not use the solvent process for separating the oil from soybean meal. They use the expeller process, so there's no solvent like hexane on the premises. AgPro's owners don't like the solvent process. McDonald said that the expeller process leaves about 5% of the soybean oil in the mash that becomes meal, which is acceptable to them. He also said, "probably 99% of vegetable oil in the grocery store is solvent-processed." Although he didn't know the exact procedure for testing hexane residue, he said there certainly should be such a test.

Gueberty details ADM's shady background

Displeased with the chemical and medical traits of hexane, I was even more upset with a company using this solvent and not returning my calls. So I tried to learn more about ADM. This challenge sparked a phone conversation with Alan Gueberty, an investigative agricultural journalist and columnist in Delavan, Illinois. Gueberty's syndicated column, "Farm and Food File," is published in about 80 newspapers nationally. He welcomed my questions on ADM, as he considers ADM the classic cockroach that scurries at any sign of light.

Gueberty said that ADM is the world's largest exporter and buyer of commodity grains. Quoting Alan, "they want to achieve a monopoly as the world's grocery store. They operate at the edge of the law, if not outside the law, although they have become slightly less illegal over the last few years. They are the largest owner of rail cars in the world, owning 20,000. They also own a barge fleet. They are a power player in (Washington) DC; they call the shots." He said that in 1995, ADM paid \$100 million in fines because of price-fixing and restraint of trade activities. Again quoting him, "I don't know why they didn't get barred from doing business with the Federal government."

Gueberty said ADM has been named in almost every criminal investigation involving grain marketing. During the 1990s he strove to get a press pass from Carla Miller to attend corporate board meetings, and was consistently denied except on one occasion. He attended a meeting, after which he never requested another press pass. Gueberty was emphatic to me: "No, Carla Miller will not return your phone

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calls. She talks to the press as little as possible.”

To illustrate his “outside the law” allegations, Guebert went on to say that ADM’s CEO is Duane Orville Andreas. Andreas went against U.S. government directives some four decades ago to visit the Soviet Union for the purpose of setting up commerce between that Iron Curtain nation and his company.

In the 1990s, Andreas’ son, Michael, spent a couple years in federal prison for price-fixing. At that time Mark Whitaker, an upper level corporate employee at ADM, turned “state’s evidence” for the FBI against his employer. He did so in an attempt to bargain for immunity for himself, as the Feds were trying to indict ADM. ADM then countered by turning over to the FBI damaging information on Whitaker. The documented proof ADM released on Whitaker’s illegal activities was so overwhelming, according to Guebert, that the feds retracted their offer of immunity. Whitaker went to prison, where he remains.

On Labor Day weekend of 1995, if Guebert’s memory serves him, as he was investigating the Federal indictment activities against ADM, he was trying to call a Decatur television station. As he dialed from his office at home, the party picking up at the other end said, “ADM Security.” This event occurred at the time Guebert was actively trying to interview Mark Whitaker.

When Guebert reported this apparent illegal wire-tapping incident to the FBI and local police, these law enforcement people basically laughed, saying this was no big deal because ADM does that kind of stuff. Guebert said that for years after that incident, his phone would “act weird, sometimes go dead.” He ended up borrowing the neighbor’s phone or using his cell phone a lot.

At the same time he was investigating ADM’s questionable activities, two other Midwest reporters were covering the ADM scandal very intensely. Both were mysteriously fired from their newspapers and, as far as Guebert knows, no longer practice journalism anywhere.

In Guebert’s closing comment to me, he stated that ADM, and specifically the Andreas family, enjoys working in as unregulated an environment as possible. As such they have been able to pull strings

to conduct business with and in Cuba. Folks who practice restraint of trade are well poised to enjoy black markets.

Other solvents caused animal health problems

The history of soybean processing reveals a few more blemishes in the animal health arena. Let me quote from my Morrison’s Feeds and Feeding by Professor Frank B. Morrison, 22nd Edition (1959): “A few years ago certain oil mills began to use trichloroethylene instead of hexane, the usual solvent, in the solvent process. Though this solvent itself is not toxic, for an unknown reason some of the soybean oil thus produced was poisonous to cattle and certain other animals. The use of this solvent was therefore discontinued.”

During the last century, in Britain, the U.S., and even Germany, there were other solvent toxicity incidents involving trichloroethylene and even carbon tetrachloride. For the chemicals to stop being used, livestock first had to get sick and die.

Still trying to get an answer for the three questions I posed to the good folks at ADM, I contacted the home office of ADM’s top competitor, the Cargill Corporation in Minneapolis. I was referred to a gentleman named Al Crose at their Lafayette, Indiana location.. However, Crose bounced me to Kent Rudeen. I called that number at the end of September, got Rudeen’s voice mail, recorded my questions, and also await his reply.

Agencies that are responsible for monitoring health aspects of chemicals like hexane in feed and food production are asleep at the switches, either accidentally or knowingly. The seriousness of this negligence is spotlighted by the words of Dr. David Rall, former U.S. Assistant Surgeon General, who now works at NIOSH: “While some species are more sensitive to toxic effects than others, laboratory studies have proven to be good predictors of health effects in humans.”

The fact that over 95% of all soybeans in the U.S. that are separated into oil and meal are processed with hexane - a carcinogen - raises serious human and animal health questions.

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