

Flour Milling in Greece

Despite a long history in grain processing, many facilities still need to modernize.

Greece, also known as Hellas, is a southeastern European country with a population of approximately 11 million. Greece has a rich ancient history and was the cradle of Western civilization.

The capital of Greece is Athens, which also is the largest city.

The Parthenon on the Acropolis is a wonderful sight to see and serves as a reminder of the prosperity it once enjoyed. Greece occupies an area of 50,949 square miles—or about 131,958 square kilometers—and the population density is about 212 people per square mile (2.60 square kilometers).

Depending on the minimum size used in designating an island as such, there are anywhere from 1,200 to 6,000 Greek islands, according to *Wikipedia*, but only about 227 are inhabited.

Greece is surrounded by the Aegean Sea to the east, the Ionian Sea to the west, and the Mediterranean Sea to the south. The Mediterranean climate of Greece is characterized by wet winters and hot, dry summers.

Trips to Greece

I've had fortunate opportunities to visit Greece in July 2011, October 2012, and again in June 2013. During each of these vis-

its, I gave a couple of lectures, which were organized by a pest management company, to Greek flour milling and food-processing industry stakeholders.

During these visits, I also had a chance to inspect several flour mills and hold discussions with mill managers regarding grain storage, sanitation, and pest management.

The lectures and inspections were organized in various cities by Vasilis Sotiroudas, CEO, AgroSpeCom (website: www.agrospecom.gr), a pest management service provider located in Thessaloniki. He is a strong advocate of upgrading the flour millers' knowledge of sanitation and pest management and also

Pest Management



Dr. Bhadriraju Subramanyam

Creason Roll Corrugating & Grinding Service



**Roll Pick-Up
and Delivery Service**

New Rolls In Stock

**Roller Mill
Conversions and Parts**

Three U.S. Locations:

*75 Years of
Service to the
Milling Industry*

**Creason Corrugating
& Machinery Co., Inc.**
Wichita, KS
800-644-0061

**Creason
Corrugating Co.**
Chattanooga, TN
888-797-1983

**Utah Machine
and Mill Supply**
Salt Lake City, UT
801-364-2812



Aerial view of the Loulis Mill located in the picturesque area of Sourpi, Greece. Photo courtesy of Loulis Mill.

to use science-based approaches to help flour mills in Greece solve pest problems.

What follows in this column are my notes on grain production and protection in Greece, along with general observations of my visits to four flour mills.

Grain Production and Storage

Greece has 9 million hectares of land (22.24 million acres) devoted to agriculture, of which 4 million hectares (9.88 million acres) are arable land, and 5 million hectares (12.35 million acres) are in pasture. Only 30% of the arable land is irrigated.

Wheat, cotton, and corn are the primary crops grown on 40% of the arable land.

Durum wheat is the predominant wheat grown in Greece occupying 600,000 hectares (2.17 million acres), which is more than twice the area cultivated in 1983. The reasons for the increase in durum wheat planted acreage is related to financial incentives given to farmers per hectare (2.47 acres), which amounts to 400 Euros or \$520 (U.S.).

Acreage devoted to barley, rye, and oats was cut back to accommodate more durum wheat cultivation. Soft wheat also is grown in Greece for making bread. The total annual production of durum wheat and soft wheat is 700,000 to 1,100,000 tons (or 23.33 to 36.66 million bushels) and 300,000 to 450,000 tons (or 10 to 15 million bushels), respectively.

Harvested wheat is stored in flat storage structures, steel bins, and concrete silos primarily between May and Septem-

ber. The flat storage structures usually are made of limestone and, to a lesser extent, sun-dried mud bricks. These types of storage structures are common in rural areas. In contrast, flour mills use more contemporary structures such as steel bins or concrete silos.

Grain stored at the village level usually is unprotected, but in urban areas, grain is protected by applying grain protectants such as pirimiphos-methyl and deltamethrin as a preventive measure. Empty bins or floor surfaces in mills are treated with pirimiphos-methyl, and the fumigant phosphine is used for disinfestation of wheat.

Recently, more interest has focused on using modified atmospheres (nitrogen) for managing grain insects.

The rice weevil, granary weevil, and lesser grain borer are the most frequently encountered species in stored wheat.

Visiting Mills in Greece

There are approximately 212 mills in Greece, with a combined daily capacity of about 13,095 tons (261,900 cwt.). The majority of the mills process wheat.

More than 50% of the mills produce less than 50 tons (1,000 cwt.) of flour per day. About 14% of mills in Greece have daily capacities exceeding 100 tons (2,000 cwt.) per day. Only two mills have a daily capacity of more than 500 tons (10,000 cwt.) per day.

All of the Greek mills are privately owned, with the exception of two, ►

Be prepared for this year's Mycotoxin Challenge!

With Romer Labs Analytical Services and the rapid test kits AgraStrip® and FluoroQuant®:

- Rapid On-Site Testing
- Highly Sensitive Strip and Fluorometric Test Kits
- Reliable Analytical Service: ISO 17025- accredited multi mycotoxin analysis

Saving time and resources!



Contact us today for our mycotoxin solutions:
Call: +1 636 583 8600
Email: office@romerlabs.com
www.romerlabs.com

Making the World's Food Safer®





On the rollstand floor at the Papafilis Mill in Kalamaki, Subramanyam (Subi) Bhadriraju takes some notes during a mill inspection. Ground-level photos courtesy of Bhadriraju.

which are owned by cooperatives. Nearly 7% of the mills process corn, oats, barley, rice, and animal feed.

Loulis Mills

I visited a total of four flour mills between 2010 and 2013. In 2010, I visited a family-owned flour mill in Sourpi.

Operating under the name of Loulis Mills, this is one of three mills owned by the Loulis family whose involvement in milling dates back to 1782.

The mill sells bagged or bulk flour, in addition to other consumer products. The company produces more than 120 varieties of flour for its customers.

The mill also has a large museum to display the products, utensils, and emblems the company used over the centuries on its breads and cakes.

The company maintains a state-of-the-art laboratory for testing flour functionality, as well as a baking and mycotoxin testing laboratory. The mill also installed chambers recently for modified atmosphere treatment of outbound bagged products. (For more information about this controlled-atmosphere type of treatment, visit the website: www.eco2.nl/en).

Products placed inside the chambers are subjected to low oxygen conditions by purging it with nitrogen. Oxygen levels observed were as low as 1% or less. Treatment times for complete disinfestations at a temperature of 95 degrees F (or 35 degrees C) can be as short as three to five days.

Asopous Flour Mill

In 2012, I visited the Asopos Flour Mill in Viotia and the Papafilis Mill in Kalamaki near Korinthos. The Asopos Mill was built in 1969 and is made mostly of concrete and was under new ownership in 1999.

It has two production lines: one for soft wheat, with a production capacity

Quick Ship

Metal Detector Program



Eriez' stocks eight E-Z Tec® metal detector aperture heights and three stainless steel, wash down conveyor widths for quick assembly and delivery. The variable speed conveyors are:

- Available in 12, 18 and 24" widths
- Food-grade polypropylene belt



Purity.Eriez.com • 888-300-3743

of 240 tons (4,800 cwt.) per day, and a durum wheat line, with a production capacity of 130 tons (2,600 cwt.) per day.

Papafilis Mill

The Papafilis Mill was established in 1984. In 1999, a durum mill was built with a capacity of 120 tons (2,400 cwt.) per day. In 2009, the durum wheat line was expanded to produce semolina at a capacity of 200 tons (4,000 cwt.) per day.

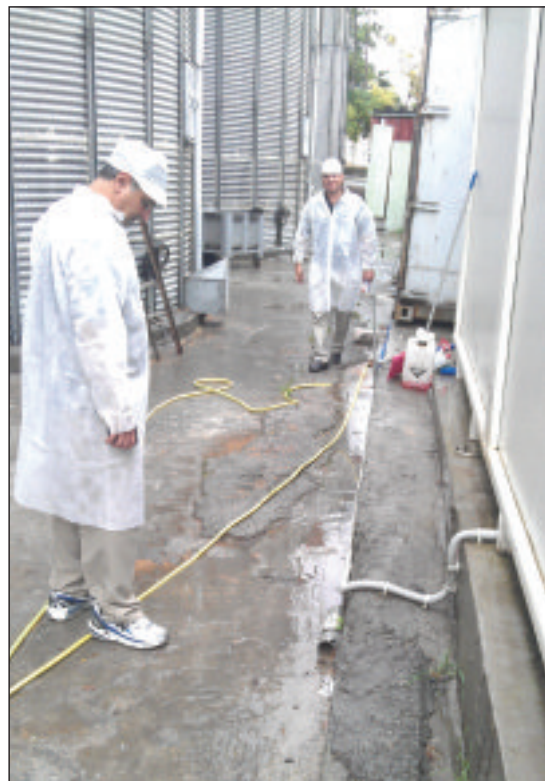
The soft flour line has a capacity of 300 metric tons (6,615 cwt.) per day. The mill sells bagged and bulk flour, and the flour yield is around 78 to 80%, according to the mill manager.

Dakos Flour Mill

In 2013, I visited the Dakos Flour Mills in Attica. This has been a family-owned business since 1875. The Dakos family operates two mills: one for soft wheat and the other for durum wheat, each producing 150 tons (3,000 cwt.) per day.

Over the last 10 years, new equipment, which came primarily from Buhler, replaced the older equipment.

Improvements were made to floor and walls to make them easier to clean. A separate site, which is located several



Bhadriraju (foreground) and Vasilis Sotiroudas, a pest-management provider located in Greece, inspect steel bin areas at the Asopous Mill in Viotia. The base of the bin has a PVC pipe with rodent bait.

Wheat is inspected by all mills at the time of receipt primarily for quality such as moisture, gluten content, protein, and falling number.

miles from the mill, is used for storing grain in concrete silos.

Wheat from this site is transported to the mill by truck. At the mill, the grain first goes through a pre-cleaner, which is equipped with a magnet to remove any trash metals.

This mill sends 76% of the flour in bulk tankers to bakeries. The mill added a new line recently to produce 1.1-, 11-, and 22-pound bags of semolina (0.5, 5, and 10 kilograms, respectively).

General Observations on Practices

Here are general observations of my visits to the Greek mills, and all of the issues listed do not apply to all of the mills. This was done deliberately to avoid singling out any particular mill.

Grain Receiving and Storage

- Wheat is inspected by all mills at the time of receipt primarily for quality such as moisture, gluten content, protein, and falling number. If insects are present, it is treated with deltamethrin when unloading into a dump pit. The dump-pit area generally had birds on overhead ledges, and this area was not kept very clean.

- Grain unloaded into the silos is treated with phosphine, if it already was infested prior to delivery. In-storage grain rarely is reinspected.

- The silo area usually is not regarded as a high-risk area, so the prerequisite systems (e.g., cleaning and pest management) are not applied here. All visited sites had issues with birds, especially pigeons.

- Most of the grain storage sites had very few or no magnets at all.

Mill Sanitation and Safety

- Sanitation issues abound in mills, because very few people are dedicated or assigned to this task.

- Some mill floors are made of tiles, and upon removing a few tiles, there

was evidence of flour accumulation underneath and the presence of insects.

Due to the age of some buildings and despite recent improvements, there are many areas where sanitation issues still exist. However, companies are continuing to make a concerted effort to improve sanitation, and tiles are being removed and replaced with smooth floors that are easy to clean.

- Many areas are not well lit.

- Good Manufacturing Practices and Hazard Analysis and Critical Control Points (HACCP) Programs are not used extensively by mills. Instead they follow the International Organization for Standardization (ISO) standard that involves increased efficiency, reduced costs, and faster delivery time to market.

- However, the ISO systems have failed to provide personnel training and an understanding of the actual risks, because inspections and corrective actions are rarely followed.

- The HACCP approach of the ISO systems, as applied by the Greek mills, is more theoretical than actual. Real torch and magnifying glass inspections are more of an exception than the rule.

- Employees wear apparel for personal safety; however, there is less emphasis on personnel hygienic practices, as it relates to food safety, because of the lack of proper government regulations and enforcement.

- Valve bags generally are used for flour, and I noticed a lot of spillage from these bags during filling and during transportation. A few mills use paper bags with a single-coarse stitch.

- Spillages are not cleaned in real time, because few very people are involved in sanitation. Sanitation tasks are delayed often, and many spillages were infested with insects such as flour beetles, warehouse beetles, and rusty grain beetles.

- The bases of equipment are not sealed to the floor. Generally, equipment is mounted on wooden panels, and the interface between the wood and flooring often is not sealed.

- Generally, windows and doors are open for air circulation, and the screens on windows are large enough, in some cases, to allow entry of stored-product insects.

- The entry doors of warehouses, which stored finished products on pallets, often were left open. This practice allowed unobstructed entry of insects, rodents, and birds into the facility. ▶

- Pallet spacing was less than adequate and did not permit for proper inspection of the stored products.

- Except for netting in one of the mills in the receiving area, I did not see any special bird management tactics used.

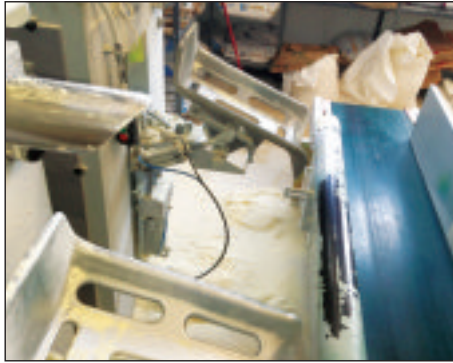
- Rodent traps were used, and these were generally PVC pipes and not really tamper-proof bait boxes.

- Mills did not have standard operating procedures for outside contractors.

- Phosphine fumigation commonly is used for grain in bins. In one of the mills, phosphine was used to control insects. Three out of the four Greek mills visited used heat treatment with a combination of forced-air gas heaters and electric heaters. Grain chillers are used by some mills to cool the grain in storage.

- Traps are not used widely for monitoring stored-product insects. Instead, traps are used at bagging stations, and I was told that it was a requirement. Light traps were used in areas other than the warehouse where finished products are stored. Also, trapping devices used for stored-product insects are very few, and it is unclear how the mills use the collected data.

- All the mills are located in open areas



During his several visits of mills in Greece, Bhadriraju found many examples of flour spillage in the packaging areas, which can attract and harbor insects.

with a lot of vegetation and water, which can attract rodents and birds and cause problems. In a few facilities, rodent fecal pellets were found on some mill floors.

- Unused equipment is typically stored on the same floor, and they are not cleaned and stored on racks. Insect trails and live insects were found in these locations.

- Most of what the mills do is based on trial and error and experiential knowledge.

- In addition, the Greek mills exhibited several positive attributes such as

good traceability systems, which connect the final products to their production records and raw material sources.

- Although some risks were found, the final product was still considered safe, because there are many preventive measures (e.g., sieves and metal detectors) to remove any foreign matter before the final product is packed.

The Greek flour milling industry has a champion in Sotiroudas who hosts food safety and pest management training sessions every year to bring in industry people and academics within and outside Greece to shed light on better ways of addressing sanitation and pest management issues.

While certain management aspects need improvement, the future still looks bright for the flour milling industry, which is flourishing despite the financial woes in Greece and Europe in general.

Subramanyam (Subi) Bhadriraju is a professor in the Department of Grain Science Industry at Kansas State University, Manhattan. He can be reached at 785-532-4092 or sbhadrir@k-state.edu

Remanufacturing
brings equipment back to life.

- ♥ D&W remanufactures blowers, airlocks & vacuum pumps back to OE specifications
- ♥ Backed by 1 year in-service warranty (from date of first installation)
- ♥ Save up to 60% VS. buying new

D&W INDUSTRIAL Contact Sandy Wise at 866.723.8099 for service on all brands today!

dwindustrial@dwdiesel.com dwdiesel.com

- Project Management
- Millwright Services
- Mill Installations
- Mill Renovations
- Repairs & Maintenance
- Crane Services
- Commercial
- Industrial
- Agricultural

417 First Street NE • PO Box 583
Grand Meadow, MN 55936
(855) 754-6711 • (507) 754-6710 fax
www.meyerhofer.com