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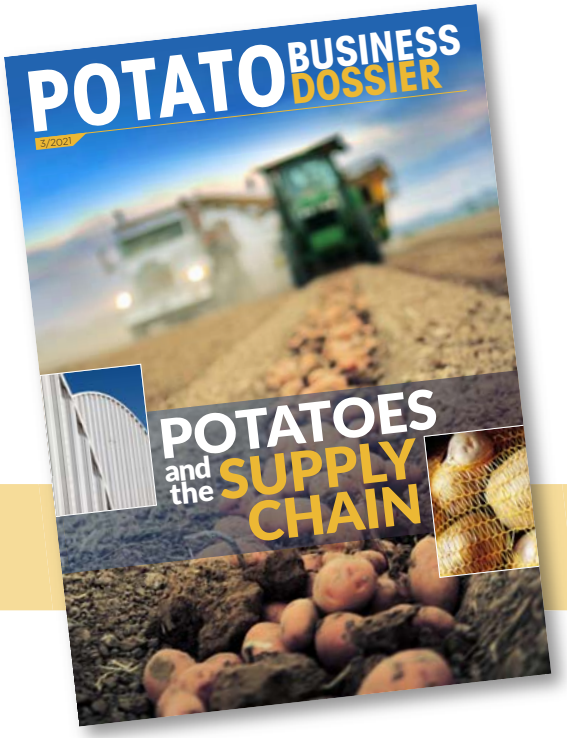

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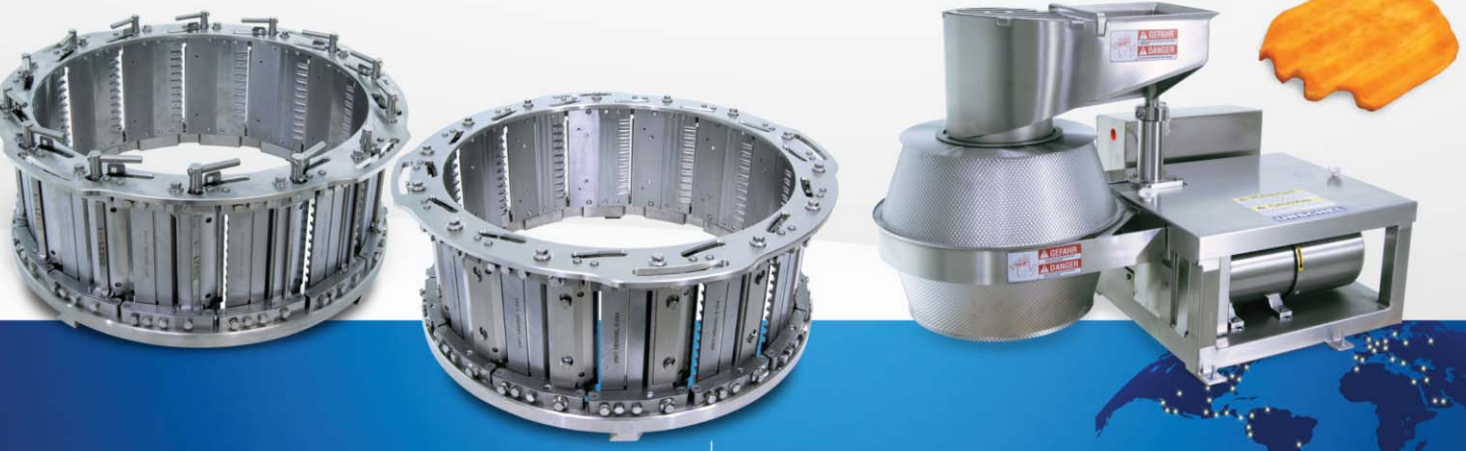

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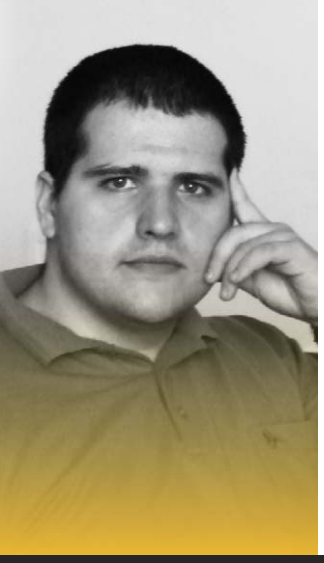

Sailing Through Rough Waters

IONEL VĂDUVA
on-line editor

Ionel Vaduva

There was a rough holiday break for the Prince Edward Island (PEI) spud growers, as they began a 2022 year with no end in sight to the ban on fresh potato exports for the US market. A significant amount of time has passed since the Canadian Food Inspection Agency (CFIA) issued the trade ban based on the discovery of potato wart on two of the PEI's spud fields.
In the interim, the PEI Potato Board has started a social media campaign to push the resumption of fresh potato exports to the Northern American territory of Puerto Rico. Moreover, the federal government has also pledged USD28m that will go toward farmers affected by the suspension of trade.
The new Potato Financing Program announced by the Province of PEI will assist eligible PEI tuber farmers impacted by the recent suspension of seed and fresh table stock potatoes entering the US through a joint partnership of Finance PEI and the Department of Agriculture and Land. Eligible applicants can apply to receive working and/or capital loans, available to assist PEI potato farms to obtain the necessary financing to address operational needs, amid other potato storage costs.
Once again, the lowest part of the potato supply chain - the producer - was forced to find a solution for 'sailing through rough waters' by stockpiling the produce. To support the grower in this situation, the utmost attention had to be given to the quality of potatoes during their post-harvest period. And by that, we mean the danger posed by the possible insufficient storage structures available, and the ignored structural and environmental principles in the design of the stockpiling facilities.
To approach the correct stockpiling of the spuds, experts say that there's a need to efficiently maintain the determined temperature and the relative humidity of the crop. In addition, the design of storage structures should follow the designated standards. To be considered in this respect are the structural standards (wall, wind, snow, crop, and floor loads), insulation (thermal requirement, fire retardant and moisture removal systems), mechanical (ventilation, heating, and humidification systems), electrical and control systems. If all these requirements are checked, all a storage period can do for the PEI potato growers is help maintain the tuber quality, and that is one of the things that the PEI farmers need right now. ■

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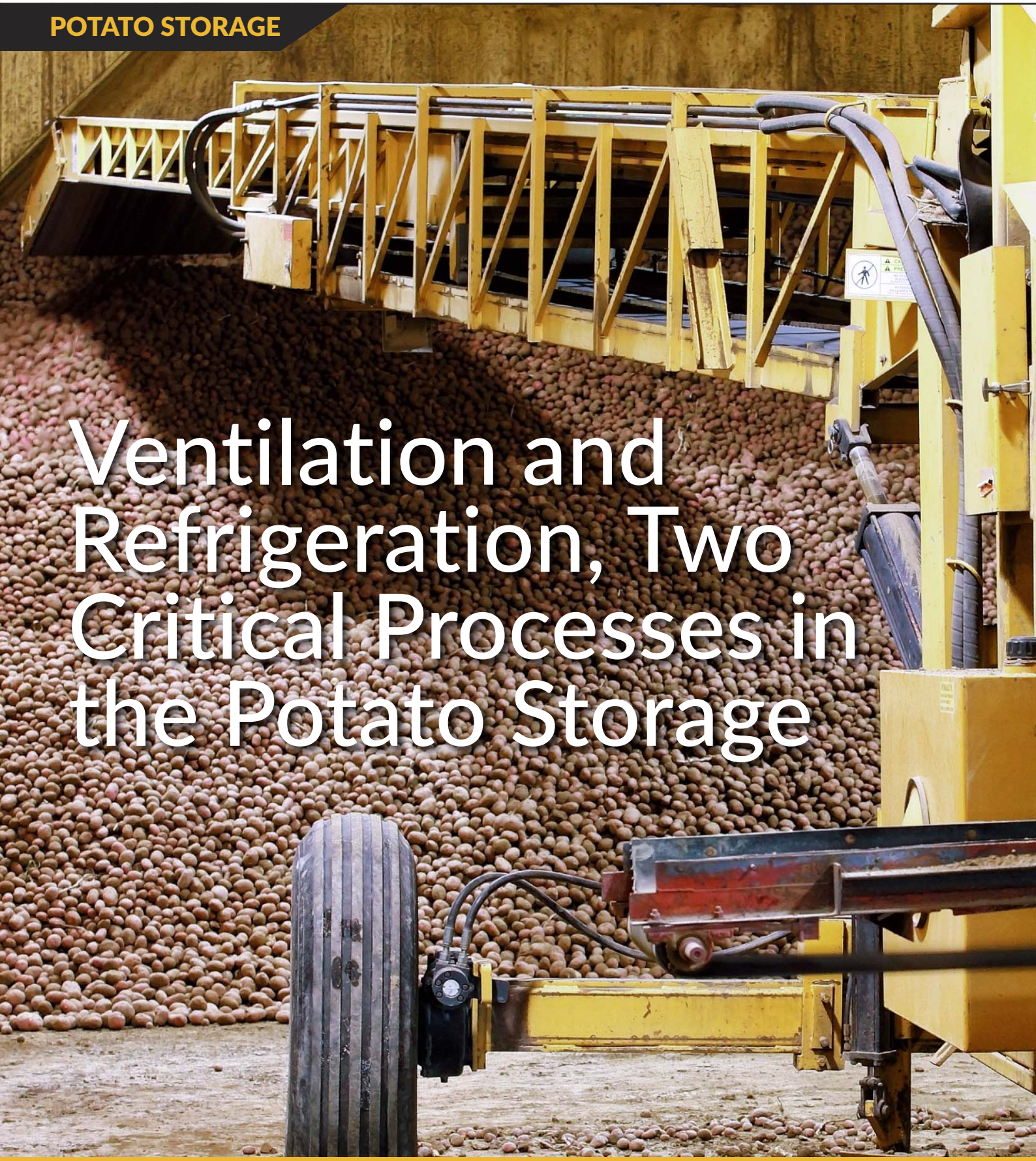

Ventilation and Refrigeration, Two Critical Processes in the Potato Storage

Ventilation and refrigeration systems play essential roles in professional spud storage, in order to maintain potato quality and prevent sprouting until the stock is sold and the new harvest arrives.

By Ionel Văduva

When considering the ventilation systems, both growers and processors increasingly require energy-efficient integrated equipment that can help with determining the correct storage temperature and in turn, the airflow needed in the ventilation of the facilities. Experts with the Washington State University (WSU) said not so long ago that if it pays to store potatoes for several months, it will pay to ventilate to maintain top quality. In general, a ventilation system should force air up through the pile of cultivars. The air must be maintained at the proper temperature and relative humidity and a practical method of forcing air through a pile of potatoes is to introduce the air into a system of delivery ducts installed under the pile.

Based on the Canadian Horticulture Council (CHC) engineers' expertise, ventilation systems capable of blending outside air with inside air should be designed to move air at a rate of no less than 1.0 cfm/cwt (20 cfm/ton) of spuds stored. Wet or field frosted potatoes or tubers affected by blight, pinkeye, blackleg, water soak, or soft rot will benefit from higher rates of ventilation (2-2.5 cfm/cwt, 40-50 cfm/ton) for rapid cooling and drying.

When potatoes are stored for a longer period in a hot or a very cold climate, outside air ventilation only is not suitable to maintain potatoes at storage temperature. In these situations, mechanical cooling is a key tool to extend the storage period and keep potato quality high. Aimed at properly maintaining potatoes for longer periods, refrigeration systems are advised to be put in place.

Refrigeration is a key process of modern-day potato production, which allows growers and agricultural companies to keep potato crops from spoiling during storage. Ensuring a storage facility runs efficiently is a critical part of managing a successful potato production system, as disease-free, firm potatoes have a much greater value on the market. Amid the recent extreme weather conditions, the need for application-specific refrigeration technology has improved in the potato market. The two critical environmental factors involved in properly storing potatoes are temperature and humidity and modern refrigeration solutions have tried tackling these specific problems.

Potato storage refrigeration technology today is vastly improved over the past four decades, with better control and ease of use.

DURABILITY – THE KEY WORD FOR TOLSMA'S TECHNOLOGY

The innovations in key potato processing technology that Tolsma is interested in right now are all related to durability. The company aims to develop products that are durable for customers and the environment.

"We are currently introducing our new fan that is designed with revolutionary motor technology. The new design reduces sound output by 36% while increasing the airflow by 7%. So a low noise level for people living close to storage and with a higher air output quick drying and cooling with outside air. More air is limiting ventilation time and limiting weight loss and energy consumption," Tolsma engineers said.

When it comes to the main challenges associated with potato refrigeration systems, Tolsma's expert says that the key to overcoming most challenges lies in automation and being in control when it comes to drying the product.

"The trick with automation is to unburden the customer and have optimal storage. With the Tolsma Vision storage computer, everything is automated. The Vision Control is easily controlled by a touch screen or mobile application and the Vision is updated continuously to improve the storage algorithms," Tolsma's experts added.

A new improvement to the cooling machines is condensation drying. This option can dry product without using separate heaters by consuming the heat produced during the cooling process. This solution makes it possible to quickly dry product in a wet year without the hassle and high heating costs. This is a cost-effective solution and environmentally friendly. When it comes to tackling the refrigerants legislation, Tolsma is making a change to a natural refrigerant. Options are ammonia, CO_2, and propane. "All of them have pros and cons," the company's specialists mentioned. "For five years already we use chiller units with propane (R290). This natural refrigerant has a low global warming potential, is widely available, has a good efficiency in both cold and warm climates, isn't toxic, doesn't require exotic pressures or materials, is already used in the potato storage sector and most important this refrigerant is future proof. We are expanding our new line of propane product capable to deliver cooling capacity from 30 kW up to 550 kW per system with direct and indirect refrigeration systems. This line consists

The two critical environmental factors involved in properly storing potatoes are temperature and humidity and modern refrigeration solutions have tried tackling these specific problems.

Potatoes stored at temperatures above **4.4°C** for more than a few months will require a sprout inhibitor.

of cost-efficient combined solutions but also more advanced systems that allow free cooling, condense drying, heating and reusing the heat produced during the cooling for other purposes."

KOOLJET: REFRIGERATION SYSTEMS PLAY A VITAL ROLE IN HELPING THE FOOD WASTAGE

Refrigeration systems today are much more advanced, efficient, and reliable compared to past refrigeration systems, which usually operate with open-type Ammonia Compressors, according to Kooljet experts. They say that in the open-type compressors, refrigerant leaks were common. The ammonia being toxic and has a pungent odor is not good for food storage like potatoes. Old Ammonia systems used water cooling towers, which are associated with water loss, big maintenance, and sometimes results in water contamination issues like E.coli and Salmonellosis. Newer refrigeration systems use Advanced Hermetically Sealed Compressors, Digital Technology, Reliable Compressor Protection Controls, Effective Electronics, Micro Processor Controlled Systems, remote monitoring, Natural Refrigerants with Low or No GWP, which are Eco-friendly.

Evaporator corrosion is one of the main problems associated with refrigeration systems used in Potato storage, Kooljet engineers also mentioned. "Usually, potatoes stored at temperatures above 4.4 degrees Celsius for more than a few months will require a sprout inhibitor. Some of the Sprout Inhibitors comprises Chlorine Fumes. Chlorine vigorously reacts with the Aluminum Fins of the Evaporator Coil and reduces the coil life," the company's experts added.

According to them, refrigeration systems play a vital role in helping food wastage. They say that refrigeration not only increases the shelf life of the fresh produce but will also preserve the food for a long time. Last, but not least, the Kooljet experts told us that the ban on refrigerants had created turmoil in the refrigeration industry.

"We had a bumpy ride, which seems to be settling. The rate of development in the new low GWP refrigerants is very promising. At present, several alternative refrigerants are available. We are currently using numerous approved Low GWP refrigerants. The future of CO_2 as a refrigerant seems to be very favorable, which is emerging at a fast pace. Kooljet is in process of designing a CO_2 prototype that can be used for Potato Storages," the company's representatives declared.

AHDB: POTATO STORAGE, A KEY ELEMENT OF MODERN-DAY CULTIVAR PRODUCTION

From energy-efficient ventilation fans, to completely integrated information systems that provide accurate temperature within potato storage facilities, the future of the potato industry is set to go to the next level. According to AHDB, ventilation is a critical process in storage, as the movement of air through the potatoes is the primary means of regulating the crop condition by drying, cooling, heating, humidifying, or adding chemical treatments.

"Specific strategies are needed for key processes, such as drying and initial pull-down, to holding temperature and for the use of refrigeration. Many potato stores, however, still employ ambient air cooling, which uses external (ambient) air, when suitable, to cool the crop. Because ambient air does not need to be mechanically cooled, running costs are about a quarter of those of refrigerated cooling," the AHDB advisor wrote in their Potato store managers' guide.

Refrigerated storage using mechanical cooling offers the scope for close environmental control, largely irrespective of the ambient condition. In stores where this control is paramount, refrigeration is, therefore, becoming an essential part of the storage toolkit.

"Even where there isn't a need for constant optimal control, a combination of ambient air cooling and refrigeration can reduce the energy required for drying and cooling when ambient conditions allow while retaining the ability to control temperatures in-store when warm temperatures prevail outside the store. With long-term storage accounting for up to 100 kWh of energy use per ton, ensuring that systems work efficiently (whether they use refrigeration exclusively or partially) will not only preserve crop quality but also help manage energy costs," AHDB experts added.

They said that refrigeration costs can be minimized if stores are well sealed. Only one, preferably a small, opening door should be required for winter access.

"Close off and seal any doors, flaps, or louvers not required for access or ventilation. Use a controller with positive closing action so that any louver that opens under wind pressure is detected and the motor acts quickly to reclose it," AHDB's engineers concluded. ■

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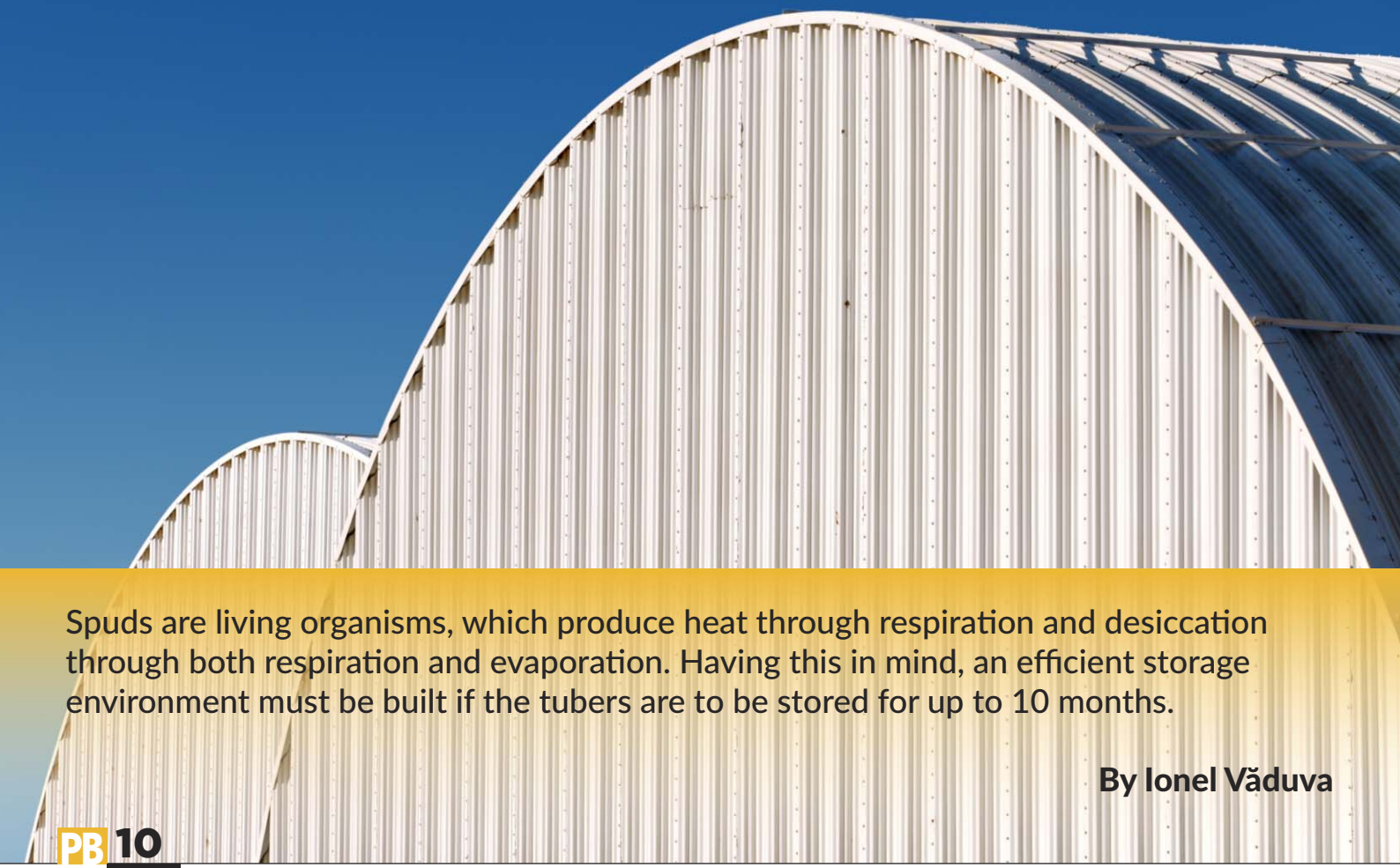
Building an Efficient Potato Storage Facility



Spuds are living organisms, which produce heat through respiration and desiccation through both respiration and evaporation. Having this in mind, an efficient storage environment must be built if the tubers are to be stored for up to 10 months.

By Ionel Văduva

In their "Storage structures and Ventilation" paper, D. Small and K. Pahl mentioned that cultivars go through four different storage phases (curing, cooling, long-term storage, and marketing), each requiring a different environment.
To meet all of these requirements, the tuber stockpiling facilities must be designed to maintain spuds at the desired temperature by exhausting the heat of respiration and circulating cool fresh air through the pile, to keep a high relative humidity to promote wound healing at harvest and to prevent tuber desiccation (shrinkage). Also, the spud storages must provide oxygen for tuber respiration, remove carbon dioxide which affects tuber quality, and deal with adverse storage conditions where the tubers are wet, rotting, chilled, frozen, or too warm.
The potato industry experts say that the utmost weight loss from spuds usually happens during the first two to three weeks of storage. During this period, high respiration rates, high moisture loss, and high heat production occur. To minimize the amount of weight loss or shrink during early storage, proper 'suberization' or wound healing must occur. All of these processes must happen in design efficient storages.

THE BIG 4: STRUCTURE, INSULATION, VENTILATION AND HUMIDIFICATION

AHDB specialists as well as the aforementioned experts agree that there are many factors to consider when choosing a potato storage design, the four most important elements being the style of structure, insulation, ventilation, and humidification.
The type of building used for potato storage varies from area to area and frequently is influenced by the availability of local materials and climatic conditions. Popular types of buildings include wood frame, vertical stud wall, gable truss roof, laminated wood arch rafters, braced rafter frame (gambrel roof - a type of gable roof with two slopes on each side), frameless steel arch buildings, pre-engineered steel frame building, and temporary pole frame, earth banked. The most common storage buildings are concrete, wood stud, and pole frame, and metal quonset (a building made of corrugated metal and having a semicircular cross-section). The factors that vary between different building types are capital cost, durability and longevity, and the type of insulation required for the exterior building envelope.

WALLS - EXTRA THICKNESS MUST BE ON THE OUTSIDE

Most modern potato storages are constructed with a framework, usually made of reinforced concrete and steel frames. The supporting pillars are linked together by lower tie-bars, which are themselves secured to the floor slab, and by upper tie-bars, which hold the frame firmly together.
The walls of the potato store are built between the supporting pillars. If the supporting posts are thicker than the walls, the extra thickness must be on the outside of the building so that the internal surfaces of the walls are smooth and free from projections. This facilitates the cleaning of the store and avoids interference with other operations as well.
A vapor-proof barrier should be incorporated into the base of the walls, to prevent damp rising and causing damage to the store structure and its contents. Also, a concrete strip about one meter wide should be laid around the outside of the warehouse, to prevent rain from eroding the base of the walls below the damp course.

THE DESIGN OF THE ROOF FRAMES

Roof frames should be designed so that they transfer the weight of the roof to the supporting columns (in framed buildings), or the walls if the store is small. A steel portal frame should be used if the span is to be greater than 15m. Stores less than this width may have reinforced concrete roof frames.
Roof frames made of wood or steel are only suitable for stores not more than four or six meters wide. The wood used must be well dried and treated with a preservative. Roof cladding may be of galvanized steel or aluminum sheeting, or asbestos-cement; the latter being more fragile but having better insulating properties. Tiles are not recommended, especially for large stores.
The roof should overhang the gables by 0,7 meters to one meter, and the eaves by at least one meter. This ensures that rainwater is shed well clear of the walls, and obviates the need for guttering and drainpipes, which may become blocked or assist rodents entering the store. The overhang also helps to keep walls cool and protects ventilation openings from rain.

DOUBLE SLIDING DOORS ARE RECOMMENDED

Doors are commonly the major source of air leakage in potato stores. The best arrangement is for there to be only one crop loading door into the store, and it should open into a second building such as a grading area so that it acts as an airlock. The door should be well-sealed and easy to open and close. The number of doors will vary according to the size of the store. If possible there should be at least two doors, to be able to rotate stocks on a 'first in, first out' basis.
Double sliding doors are recommended. Preferably made of steel, or at least reinforced along their lower edges with the metal plate as protection against rodents, they should be sufficiently large (at least 2,5 by 2,5 meters) and close-fitting. If swing doors are

Popular types of buildings include wood frame, vertical stud wall, gable truss roof, laminated wood arch rafters, braced rafter frame (gambrel roof - a type of gable roof with two slopes on each side), frameless steel arch buildings, pre-engineered steel frame buildings, and temporary pole frame, earth banked.

fitted they should open outwards in order not to reduce the storage capacity of the warehouse. It is recommended that the doors be protected from rain by an extension of the roof or a separate cover. Sliding doors designed for food chillers also make good entrance for potato stores. The track is so designed that when the door is nearly shut, it moves laterally so that it seals against the frame of the doorway on all four sides.

Under normal storage conditions, the relative humidity of the supply air should be maintained near **98%.** Humidifiers should be installed immediately downstream from the fan(s).

KEEPING A STABLE TEMPERATURE

Storages must be properly insulated and sealed to maintain the environment required to keep stored potatoes healthy. Besides reducing heat loss and thus helping to maintain the desired storage temperature, insulation is also critical in preventing condensation. Condensation water, dripping onto the tubers, will encourage the development of soft rots and can significantly impact potato quality. It is recommended that enough insulation be installed to achieve a minimum thermal resistance (RSI). This is equivalent to 10 inches (250 mm) fiberglass or 6 inches (150 mm) of polyurethane insulation. Ceiling fans have also proved beneficial in reducing free moisture on ceiling surfaces and/or the top of the potato pile.

The quality of the insulation will determine to a large extent how well a potato store performs. Insulation is a key factor for a potato store, much more so than it is for general purpose buildings. Fabric or door leakage to wind-induced ventilation reduces the effectiveness of the store, as it is likely to lead to loss of environmental control. Crop weight loss and possible condensation on the produce will result as ventilation or refrigeration running hours will increase, to cool the crop warmed by the leaking air. The amount of insulation also impacts interior air quality. Insulation decreases heat loss through the walls and ceilings, resulting in more heat of respiration exhausted from the building via the ventilation system. In extremely cold weather, this allows the ventilation system to bring additional fresh air into the building, thus maintaining adequate levels of oxygen and reducing the level of deleterious gasses such as CO_2.

VENTILATION IS ESSENTIAL

Ventilation is the most important factor for maintaining the correct temperature, relative humidity, and air quality in the storage. It is also essential for managing potential storage problems caused by disease or frost. The basic ventilation system design is similar, regardless of the type of storage structure. A typical ventilation system consists of intake door(s), fan(s), air plenum(s), ducts, exhaust louvers, and a control system.

The size of the intake doors, air plenums, ducts, duct outlets, and exhaust louvres must be carefully selected to ensure that the ventilation air is evenly distributed throughout the storage. Intake dampers should be designed to close the return air supply proportionally as the intake door is opened. As more fresh air intake is required, return air carrying excessive heat or humidity will be forced out of the building through the exhaust vent(s).

"This can be particularly helpful when trying to remove excessive field heat at harvest. The addition of refrigeration coils, humidification units, and light traps in the exhaust louver all impact the resistance to airflow and must be considered when selecting the ventilation fans," the experts say.

Most control systems utilize a single insulated damper to control the blend of fresh and return air. A heating system, in the perimeter of the damper, is used to prevent freezing of the damper in cold weather. Heavy-duty screw-type actuators are used to adjust the position of the damper.

Ventilation controllers vary in complexity, depending on the number of control strategies. The simplest strategy involves running the fans continuously. The volume of air is manually adjusted through the number of fans operating or by adjusting the speed of the fan(s).

Few ventilation control systems include a humidistat because they are inaccurate when the relative humidity is >90% and have been of limited value controlling humidity in potato storage.

"Under normal storage conditions, the relative humidity of the supply air should be maintained near 98%. Humidifiers should be installed immediately downstream from the fan(s)," experts added. Three types of humidifiers are commonly used: high-pressure nozzles, centrifugal spinning disks, and water-saturated fibrous media. The first two types are used less frequently as they are difficult to regulate, resulting in either too much or not enough water added to the air streams. The third type humidifies the air as it passes through a fibrous media without the measure of free water droplets that can affect potato quality. This type of humidification unit will create resistance to the airflow and must be sized accordingly.

"The design of a humidifier is critical and must be undertaken by someone with expertise in ventilation and humidification," the engineers concluded. ■

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Everyday Challenges of Potato Transportation

Spuds can be shipped in several different ways depending on the type and availability of shipping space, transshipment, and final destination as well as requirements stipulated by the authorities of the importing country and the buyer.

By Ionel Văduva

Potato transportation is generally broken down into three stages: pre-process, during-process, and post-process. In pre-process, most customers transport potatoes by truck, typically in 40-foot enclosed vans. An alternate means is by rail car. Potatoes can also be shipped loose in bulk or by placing them in 0,90 to 1,36 tons crates or totes. Last, but not least, there is maritime transport for large quantities and long distances.

Different cargo handling procedures describe tubers displaying second-order biotic activity. "They are living organs in which respiration processes predominate because their supply of new nutrients has been cut off by separation from the parent plant," Transport Information Service (TIS-GDV) experts say. They added that care of the cargo during transportation should be aimed at controlling respiration processes (release of CO_2, water vapor, ethylene, and heat) in such a way that the shipment is at the desired stage of ripeness on reaching its destination.

"Inadequate ventilation may result in fermentation and rotting of the cargo as a result of increased CO_2 levels and inadequate supply of atmospheric oxygen," TIS-GDV specialists added.

The cultivars shipped in the pre-process stage must also be protected from light (daylight, sunlight, and even artificial light in the hold), since the light, on the one hand, causes the activation of growth-promoting enzymes (sprouting), resulting in nutrient loss and thus quality degradation (consistency, flavor), and on the other hand causes the tubers to turn green, which may give the potatoes an unpleasant, bitter taste due to an increase in solanine, present in particular at the stolon end of the tuber.

GUIDELINES FOR THE TABLE AND SEED POTATO TRANSPORTATION

Based on the BMT's CargoHandbook, due regard should be given to not mixing different types/batches of table potatoes as it may cause cross-infection.

Table potatoes are perishable and should be handled with care to avoid breaking and cracking. They should never be treated roughly and never loaded wet. They also should not be stockpiled over eight tiers in height as bottom tiers are liable to damage from over-stowing. This particularly applies to potatoes in bags, frail crates, or cases.

Potatoes should be stockpiled in a cool, dry, well-ventilated hold at approx. 7°C. Potatoes are subject to damage by excess heat and moisture, which cause them to start sprouting, and excess drying conditions, which cause evaporation and shrinkage.

"It is, therefore, important that correct temperature and humidity are maintained by electrical ventilation, giving a minimum of 14 but preferably 16 changes per hour, to prevent the accumulation of CO_2 and to ensure a constant supply of fresh air," BMT's experts mentioned in their document.

The same rules apply to seed potatoes as to table potatoes and every care should be taken in handling them. Freezing or excess drying prevents the potatoes from sprouting and excess moisture causes the potatoes to grow long weak sprouts, which are broken off in subsequent handling. Humid conditions encourage any bacterial and fungal diseases present to spread more rapidly through a sack, with subsequent damage to surrounding sacks.

"Care must be exercised in differentiating between loss due to inherent vice and that caused by normal mishandling of sacks. This is, of course, a matter for expert advice to avoid any subsequent controversy," the above-mentioned consultants also mentioned.

When shipping seed potatoes there are often several different varieties included in cargo and it is important that any burst bags be refilled with care and that potatoes that have been spilled be rebagged quite separately. "In both cases, the bags should be marked accordingly, as a farmer mustn't receive mixed varieties as each variety has its characteristics, e.g., earliness, shape, color, use, etc., which makes the subsequent crop if mixed, unacceptable to the consumer," the consultants added.

Refrigerated carriage of potatoes has one potential hazard, which is not always appreciated. If a cold cargo is discharged into a warm humid atmosphere, there is a grave risk of condensation followed by anaerobiosis, followed in due course by massive bacterial soft rot.

"It is therefore prudent (starting several days before arrival) to allow the cargo to warm to a temperature above the expected atmospheric dew-point. Even in the absence of condensation, there remains a possibility of losses from bacterial soft rot if potatoes are held in warm, ill-ventilated conditions after discharge," BMT's engineers wrote in their guide.

FACTORS THAT INFLUENCE HUMAN HEALTH

According to TIS-GDV specialists, spuds are sensitive to mechanical stresses during transportation, usually by land and especially by sea, due to the large quantities of stockpiled potatoes. Care should be taken to ensure that the potatoes have been held in storage for at least the so-called wound healing period (10 – 14 days postharvest) before transport so that any injuries caused to the tubers during harvest may have healed and no rot phenomena will occur during transport.

If ventilation has been inadequate (frost) or has failed to owe to a defect, life-threatening CO_2 concentrations or O_2 shortages may arise.

"That's why, before anybody enters the hold, it must be ventilated and a gas measurement carried out," experts recommended. Over relatively long transport periods, potatoes may lose up to 10 – 15% in weight due to respiration processes and water vapor release. This loss is accompanied by a reduction in nutrient and vitamin content as well as impaired consistency and a reduction in the proportion of aroma substances in the tuber. Due to their high water content, in particular, potatoes have a tendency towards large losses caused by mechanical damage including torn, chopped,

It is, therefore, important that correct temperature and humidity are maintained by electrical ventilation, giving a minimum of 14 but preferably 16 changes per hour, to prevent the accumulation of carbon dioxide and to ensure a constant supply of fresh air.

squashed, or cut tubers, which are classified as mechanically damaged if the damage extends to more than 5mm below the surface.
"Very loose-skinned potatoes also fall into this category, if over 25% of their skin is missing or loose," professionals declared. Animal damage is caused when potatoes are eaten by worms, snails, and mice. "Onboard an ocean-going vessel, for example, there is a particular risk of the introduction of rats and mice. For this reason, increased attention should be paid to nibbled tubers and rat and mouse droppings," the above-mentioned consultants stated.
In the case of freezing injury, the tuber skin can be easily detached and the damaged tissue parts become watery and soft. After a relatively long period of chilling, the tuber flesh displays a dark marbled effect when cut open.
Last, but not least, the damage due to chemicals is when the transported spuds come into contact with fertilizing salts or other corrosive chemicals, the skin and tuber flesh are destroyed by the corrosive action of these chemicals.
The best-known potato rots, caused by temperatures > 20°C, high humidity, and inadequate air circulation, may occur during transportation. The most usual diseases are tuber rot or late blight. This is a fungal disease caused by the fungus Phytophthora infestans and may be recognized from the lead-gray, sunken spots of indeterminate shape which cover the tuber surface and extend into the tuber flesh as brown to red areas which are unclearly defined relative to the healthy tissue.
"Late blight may spread very extensively in only a few days. It is often not detectable at the time of sampling but may assume considerable dimensions during maritime transport. Additional bacteria frequently penetrate through the affected tissue, causing so-called wet rot, which has no common origin with late blight," transportation experts declared.
The wet rot is caused by bacteria (Pectobacterium carotovorum), which penetrate the flesh of damp or damaged potatoes, often through small cracks, and turn it mushy. Often, a tuber suffering from wet rot is still firm, while the rest is brown and soft. The disease may spread through an entire cargo within just a few weeks. The bacteria either attach themselves to a damaged tuber or have already attacked the tuber previously during growth through black-leg stems.
"This tuber wet rot may have devastating consequences. The disease is suppressed by cool, dry stowage and regular ventilation. Potatoes suffering from wet rot crush easily in the hand: all that is required is finger pressure on the affected point, the mushy mess that is discharged being the characteristic feature of wet rot. Diseased tubers are often squashed by the pressure of potatoes lying on top, allowing the bacteria to go on to infect healthy potatoes. This makes wet rot difficult to suppress, and it frequently leads to loss of the entire cargo," the consultants added.
Lastly, the dry rot is discernible from sunken points and staining. The white mold is discernible from a white, fluffy mealy deposit on the tuber surface. The heart rot is determinable from the cavities inside the tuber.

>10

days shipping time requires knitted jute or polypropylene bags. It is not recommended to use paper bag packaging if the total time of the potatoes in a closed environment exceeds this period.

PACKAGING REQUIREMENTS FOR TUBER TRANSPORTATION

Craft paper bags absorb moisture from the atmosphere and lose strength in the process, according to PPECB's procedure of potato transportation. It eventually disintegrates due to any cargo movement or when handled during offloading.
"It is therefore recommended to use two or three-ply bags. It is not recommended to use paper bag packaging if the total time of the potatoes in a closed environment exceeds 10 days. Knitted jute or polypropylene bags must be used for journeys exceeding 10 days. Potatoes are sometimes handled overseas in 1,000 kilos bulk sling bags," PPECB experts say. Palletization of the bagged potatoes is highly recommended in all cases. The pallet allows for unitized handling and allows for bottom air circulation. Exporters must confirm with the buyers on the size and mass of the bags required.
Very often exporters and buyers want to keep total costs to the absolute minimum by avoiding refrigerated transport. Although not always necessary, storage and transport under temperature-controlled conditions can reduce quality losses substantially. Integral refrigerated containers, also known as reefer or integral containers are fitted with a cooling unit that is powered by an external electric power supply. Integral containers are designed and built to carry product at a specified temperature and not to function as a mobile cold store to precool warm products.
"Precooling of the product to within 1°C from the container temperature setpoint (specified carrying temperature) is essential. Warm loading results in hot spots in the center of pallets and towards the door end of the container," specialists advise.
Ventainers or fantainers are containers fitted with an air extraction fan continuously circulating fresh air over and through the product. There are several different designs available ranging from permanently fixed fans to lose nonreturnable types. Open side containers have one or both sides replaced with steel reinforcement and heavy diamond mesh wire. This concept is much better than open doors and allows for plenty of fresh air circulation. Tarpaulins must be fitted and rolled down during bad weather. If this is not done, rainwater may enter the container.
Finally, the transporter must be sure that the cargo is properly secured at the open doorway to prevent cargo from falling out, particularly on road and rail transits. The latter will usually require special permission. Ensure road weight regulations are not breached. ■

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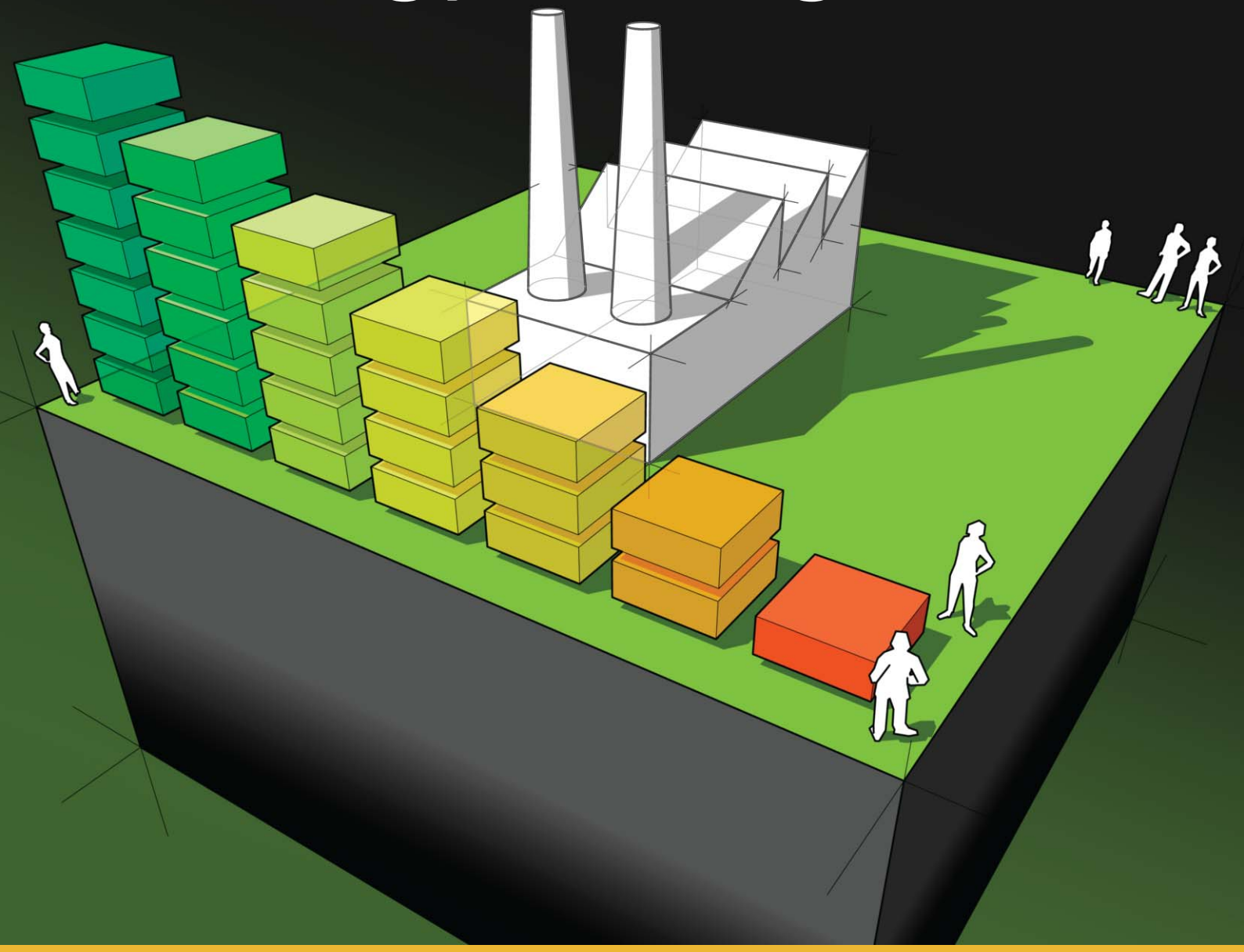
Monitoring Consumption, a Key Factor in Energy Management



Cooling the spud crop, no matter if using ambient or refrigerated air, represents the biggest consumer of energy during storage. Overseeing consumption is a key factor in handling energy use successfully.

By Ionel Văduva

Energy consumption management can vary from the regular, organized reading and manual recording of utility meters on site, to the use of sophisticated data-logging equipment, AHDB experts say. It can be applied to whole sites or, by sub-metering, to individual buildings and pieces of equipment. Store-specific metering is recommended.

If measuring each storage facility individually is not practical, energy use per unit can be estimated from fan and fridge hours' runtime. For each stockpile, total the power rating in kW or HP stamped on the electric motors that run when the ambient air cooling is operating and when the refrigeration is running.

The review of the energy costs and comparison with benchmarks is called an audit, and it is a key step in learning what are the areas where savings can be accomplished.

"Comparing the cost of current electricity suppliers with other suppliers, contracts, or changing tariffs may be a way of saving money. Specialist energy brokers can assist with this process," specialists advise.

IT'S ALL ABOUT ENERGY EFFICIENCY

The outflow of warm ambient air into storage facilities through gaps in the structure, joints, and doors is a basic cause of condensation. It also steers to excessive cooling fan or refrigeration running costs.

"Major air-leakage points are obvious, as daylight can be seen through the gaps from inside a dark store. Other leaks, such as gaps between composite panels, may only be identified by detecting gulps on a windy day or by the use of equipment such as a thermal-imaging camera. Simple solutions can often help minimize air leakage and, consequently, reduce energy use," experts recommend.

Inverters can improve the energy efficiency of fans and fridge components, such as condensers and compressors, by moving away from a one-size-fits-all approach. Instead, they pair the efficiency of the equipment to the store's needs.

"Be aware that a fan will often consume energy equivalent to its capital cost within as little as one season. So, when upgrading equipment, the extra cost of new technology or a more efficient motor needs to be offset against the delivery of energy savings. Good control is essential in providing optimal storage conditions at the lowest energy cost. Compared with many capital investment options, control is generally quite cheap to integrate into an existing store," engineers explained.

It is of utmost importance for potato storage builders and owners to maintain good records if there is a desire to improve spud storage efficiency. Specialists say that in the absence of these records, it is difficult to assess whether changes are real and worthwhile or simply an aspect of the many variables that relate to storage use.

"For example, a simple change in storage duration of a week between seasons could easily hide a 2% difference in energy consumption. If major decisions around the use of a store are contemplated, consider engaging a specialist energy-auditing service, which will highlight where true energy savings can be made," AHDB added.

SAVING ENERGY AT A LARGE PROCESSING PLANT

To reduce energy consumption and costs, the J.R. Simplot Company completed a project not so long ago that increased the efficiency of the steam system at its potato processing plant in Caldwell, Idaho. The project was based on an evaluation, performed using the Steam System Assessment Tool (SSAT).

The Caldwell plant improvements are saving 52,000 MMBtu and 526,000 kWh annually. Energy and maintenance cost savings total USD329,000 per year. Since total project costs were USD373,000, the simple payback is less than 14 months. Similar efficiency measures were replicated at other Simplot facilities, following analyses conducted using the SSAT. Those energy efficiency improvements are yielding natural gas savings of 176,000 MMBtu per year.

DISHING UP HOT CHIPS WITH A SIDE OF LOWER GREENHOUSE GAS EMISSIONS

McCain Foods' Timaru plant is reducing its energy usage environmental impact, redirecting its attention to electrification. The plant operates 24 hours, seven days a week to process potatoes into a range of consumer frozen chip products. Energy demand is significant, with one of the

Be aware that a fan will often consume energy equivalent to its capital cost within as little as one season. So, when upgrading equipment, the extra cost of new technology or a more efficient motor needs to be offset against the delivery of energy savings.

24/7 is the standard operating schedule of most large potato processing plants.

highest demands coming from the pre-treatment of potatoes. Until recently, McCain used steam from the burning of coal in the pre-treatment process. The business has now slashed its coal consumption by installing Pulsed Electric Field Technology (PEF).
Contributing to the business's global commitment to a 50% reduction in CO_2 emissions of their plants by 2030, the PEF system means the company will not only save approximately 4,800 tons of CO_2 each year but also around 52,000 gigajoules (GJ) of energy through increased efficiency and reduced wastage. The electric field pulsed through uncut potatoes during processing results in less breakage when cutting, and therefore less waste. It significantly reduces energy and water consumption, and after PEF treatment, less oil is absorbed by produce upon deep frying.

INNOVATIONS FOR IMPROVING SUSTAINABILITY AND REDUCING COSTS

GEA has witnessed a considerable drive from its customers in the French fries and other food processing sectors to embrace effective, sustainable technologies for preservation and storage. By installing efficient cooling and freezing solutions producers, it can significantly improve the overall energy efficiency of the production process, as well as reduce greenhouse gas emissions.
GEA has developed innovative technologies that improve the efficiency, reliability, and sustainability of refrigeration and freezing systems, and also reduce the total cost of ownership. The company's innovations include the valve station control system for feeding refrigerant into the evaporator. This system precisely controls the air temperature and refrigerant circulation, resulting in improved product quality and energy savings.
GEA has also developed heat pump solutions that can channel the heat removed from the freezer to elsewhere in the production process, for example, to heat water, for cleaning, or even for use in the process of drying the French fries before they are fried.
With ever-increasing energy costs, a higher profile for environmental issues, and the carbon footprint of storage, understanding energy use and exploring energy-saving options such as solar panels are now high priorities. ■

POTATO PROCESSING
INTERNATIONAL

2022 Feature Planning

1 JANUARY/FEBRUARY
Ad closing 17.01/Publishing 28.01

Key Exhibitors Road Map and Event Agenda

Processes
- Conveying systems and belts
- Pre-cleaning, washing, de-stoning

Expert View
- Conveyors and the transfer of potato products
- Remote maintenance and customer service
- Cutting technology advancements

Spotlight
- Cleaning and sanitation

Markets
- Western Europe

Products
- Better for You potato products

Ingredients
- Lowering salt sontent

Storage Special
- Handling potatoes to & from storage
- Bulk vs. boxed storage

Trade shows: Potato Expo | Jan 6-7, Fruit Logistica | Feb 9-11, International Potato Technology Expo | 24-25 Feb

2 MARCH/APRIL
Ad closing 14.03/Publishing 25.03

Key Exhibitors Road Map and Event Agenda

Processes
- Sorting
- Process monitoring
- Seasoning & coating

Expert View
- Optical sorting - increasing yields
- Automation - ensuring a reliable and flexible production flow

Spotlight
- Smart production & Industry 4.0

Markets
- Eastern Europe

Products
- Potato-based snacks, drinks and innovations

Ingredients
- Flavors and seasonings for chips and fries

Storage Special
- Automated climate control
- Potato monitoring & quality assurance

Trade shows: Anuga FoodTec | 26-29 Apr

3 MAY/JUNE
Ad closing 09.05/Publishing 20.05

Key Exhibitors Road Map and Event Agenda

Processes
- Cutting, peeling, slicing
- Energy and water saving
- Oil filtration systems & de-fattening

Expert View
- Precision in cutting equipment
- Sustainability in production

Spotlight
- Waste management

Markets
- North America

Products
- Local vs. international tastes in potato snacks

Ingredients
- Frying oils

Storage Special
- Power saving and sustainability
- Storage design and construction

Trade shows: WPC | May 30-June 02, Europatat Congress | 29 - 30 May, Snackex | 06-07 June

4 JULY/AUGUST
Ad closing 18.07/Publishing 29.07

Processes
- Blanching, frying
- Forming and extruding

Expert View
- Latest frying technology developments
- PEF applications and advantages

Spotlight
- Increasing efficiency in potato processing

Markets
- South America

Products
- Potato chips flavors, textures and trends

Ingredients
- Batters, coatings

Storage Special
- Sprout suppressants in storage
- Sensors and data gathering

Trade shows: Potato Association of America Annual Meeting | July, Potato Europe | 6-8 September

5 SEPTEMBER/OCTOBER
Ad closing 05.09/Publishing 16.09

Processes
- Cooling and freezing
- Dehydrating

Expert View
- IQF freezing for French fries
- Drying - innovation in selt and drum dryers

Spotlight
- Traceability along the potato value chain

Markets
- APAC/ANZAC

Products
- Frozen French fries in retail & foodservice

Storage Special
- Refrigeration and long-term storage
- Disease Management

6 NOVEMBER/DECEMBER
Ad closing 07.11/Publishing 18.11

Processes
- Turnkey projects
- PEF technology

Expert View
- Complete lines for processing
- Conveying systems & inspection tables
- Batch vs. continuous frying

Spotlight
- Increasing production capacity/Future-proofing processing operation

Markets
- Global market predictions for 2023

Products
- Flakes, pellets and mashed potatoes

Ingredients
- The future of potato snacks 2023

Storage Special
- Storage challenges and cost-saving solutions
- Store preparation and hygiene

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