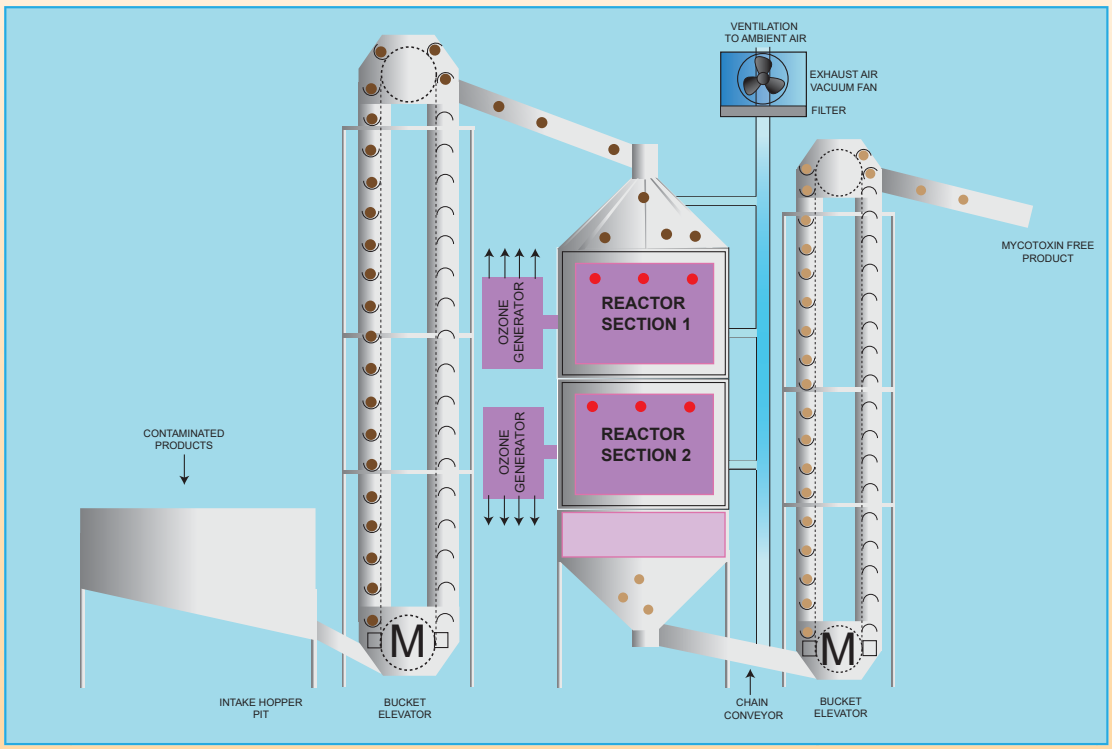
iGRAIN®

TOXI-SCRUB®

MYCOTOXIN SCRUBBER LINE

Efficient removal of mycotoxin and fumonisin



TURN YOUR BAD GRAIN OR CONTAMINATED CAKE INTO PROFIT

REMOVING

Mycotoxins
Aflatoxin
Ocratoxin
Vomitoxin
Citrinin
Ergot Alkaoids
Patulin
Fumonisins
Zeralenone

MATERIALS FOR TREATMENT

Grains:
- Wheat
- Corn
- Barley
- Rice
- Oats

Nuts:
- Peanut
- Soy bean
- Walnuts
- Hazelnuts
- Pistacio
- Coconut

Cake:
- Peanut Cake
- Soybean Cake
- Palmnut Cake
- Cotton Seed Cake

ATEX ISO TÜV IECEx

TOXI - SCRUB SYSTEM®

Effects of Ozone

How does Ozonation work? Ozonation is the process in which the grain commodity is exposed to Ozone. Ozone is a strong oxidizer and the effect is dependent on eg. the ozone concentration, the exposure time and other parameters. The effect of Ozone has been known for many years and Ozone plays a major role in many applications in other industries, of which the most important is: water treatment- to reduce BOD (Biologic Oxygen Demand) in waste water. Also sanitization in the food especially mill processing industry eliminating bad flavors and odors.

Detoxification - Eliminating Mycotoxins and Fumonisins

When a material has been infested with Fungus it will enevitable be contaminated with Mycotoxin and fumunosins. The type of Mycotoxin depends on which type of Fungus the material has been infested with. In any case, almost all Mycotoxin have a chemical structure that can be attacked with Ozone, where by Mycotoxins can be eliminated. The proportion of reduction is dependent on various factors. The TOXI-SCRUB has different treatment programs and can be adjusted to make the necessary treatment to bring the contamination well below allowed levels. It is a big advantage that the TOXI SCRUB can eliminate not only Mycotoxins, but other biologic activity as well eg. bacteria, mites and insects.

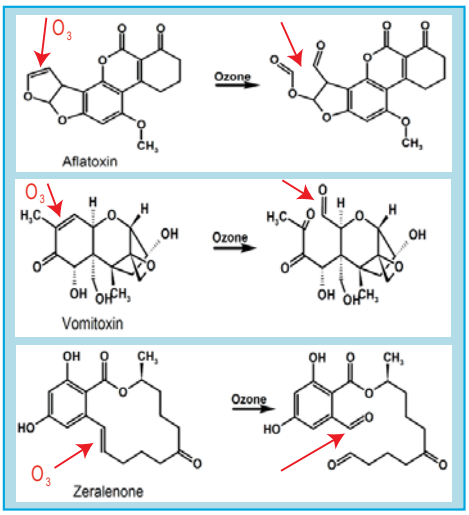
Scientific Validation

Many scientific studies have demonstrated that Mycotoxin can be eliminated by Ozone. Summary of some recent studies involving mycotoxin decontamination in food by Ozone.

Food	Mycotoxin	Reported Treatment	Reduction levels	Reference
Wheat grain	AFB_1	0,004%of O_3 in air for 20 min	96,60%	El-Desouky et al. (2012)
	AFB_1	O_3 at 60 µmol/mol for 180 min	96,60%	Savi et al. (2014b)
	AFB_2	O_3 at 60 µmol/mol for 180 min	84,50%	Savi et al. (2014b)
	Citrinin	O_3 at 60 µmol/mol for 180 min	75,27%	Savi et al. (2014b)
	DON	O_3 at 60 µmol/mol for 180 min	100,00%	Savi et al. (2014b)
Corn flour	AFB_1	75 mg of O_3/L for 30 min	78,70%	Luo et al. (2010)
	AFG_1	75 mg of O_3/L for 30 min	73,70%	Luo et al. (2010)
	AFB_2	75 mg of O_3/L for 30 min	70,60%	Luo et al. (2010)
Peanut	AFT	6.0 mg og O_3/L for 30 min	65,80%	Chen et al. (2014)
	AFB_1	6.0 mg og O_3/L for 30 min	65,90%	Chen et al. (2014)
	AFB_1	50 mg of O_3/L for 60 h	89,40%	Diao et al. (2013)
	AFT	21 mg of O_3/L for 96 h	30,00%	Alencar et al. (2012)
	AFB_1	21 mg of O_3/L for 96 h	25,00%	Alencar et al. (2012)
Pistachio	AFB_1	9 mg of O_3/L for 30 days	23,00%	Akbas and Ozdemir (2006a)
	AFT	9 mg of O_3/L for 30 days	24,00%	Akbas and Ozdemir (2006a)
Brazil nut (in shell)	AFT	14 mg of O_3/L for 30 days	100,00%	Giordano et al. (2010)
Flaked red pepper	AFB_1	66 mg of O_3/L for 60 min	93,00%	Inan et al. (2007)

The reaction mechanism

Basically Ozone works by oxidizing double bonds, thereby breaking the molecular structure and creating new NON-TOXIC molecules.



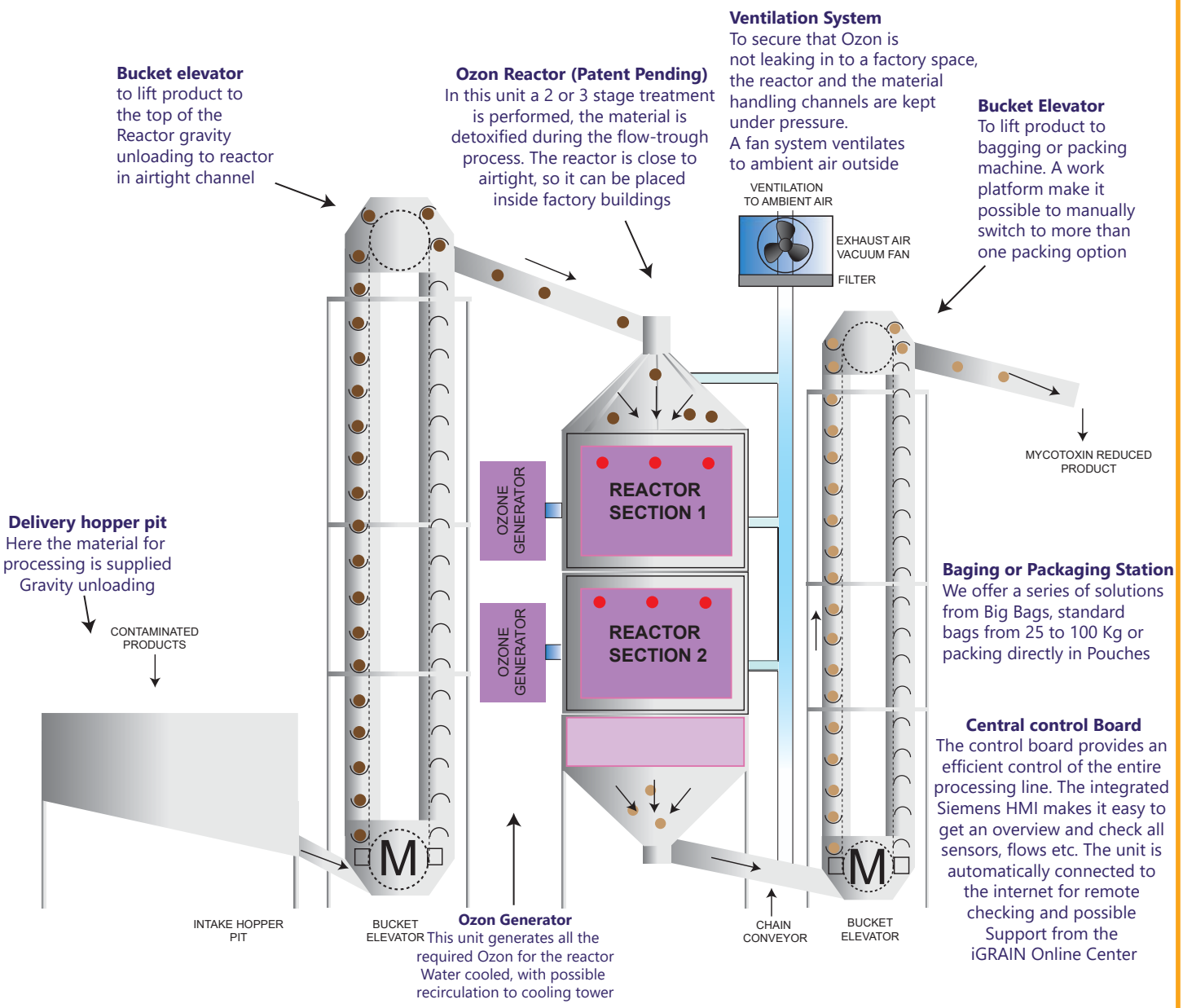
AFLATOXIN B1 – Aflatoxin exists in different versions, but they all have the same double bond that Ozone can attack. The resulting compounds can be different, but none are recognized as toxic. The main reaction shown creates a non toxic double Aldehyde.

DON or VOMITOXIN – Is also Oxidized by Ozone into a non toxic Aldehyde.

ZER or ZERALENONE – Is also Oxidized to a non toxic double Aldehyde.

THE PROCESSING LINE

The design of the processing line is made as an ALL-IN-ONE design from delivery of raw material in the incoming pit until packaging. The material handling is done in a closed and airtight system. This is important because the Ozone must not leak in to the factory floor. The client may choose his own supplier of packaging machine, but due to the nature of Ozon we recommend to go with our suggestion; we only use materials resistant to Ozon. Our packing options include: Big Bag (1 ton), Bags (25 – 100 Kg) and Pouch Machine (100 gr to 1000 gr). All processing lines are tailored to client specification.



TOXI SCRUB PROCESSING LINE		
Type	Application	Capacity
Labolatory TOXI SCRUB TESTER	Testing of detoxification efficiency	2kg
TOXI SCRUB NUTS	Scroubbing of Mycotoxin in pistacio, basil, cashew nuts	100 kg/h
TOXI SCRUB 4	Grain, serials, oil processing cake	4 t/h
TOXI SCRUB 12	Grain, serials, oil processing cake	12 t/h

MYCOTOXIN

Mycotoxin and Fumonisins - what is it ?

A mycotoxin (from Greek mykes, ``fungus`` and toxikon, ``poison``), is a toxic secondary metabolite produced by organisms of the fungus kingdom and is capable of causing disease and death in both humans and animals. The term 'mycotoxin' is usually reserved for the toxic chemical products produced by fungi that readily colonize crops. One mold species may produce many different mycotoxins, fumonisins and several species may produce the same mycotoxin.

Major groups of Mycotoxins include:

Aflatoxins is a type of mycotoxin produced by Aspergillus species of fungi, such as A. flavus and A. parasiticus. The umbrella term aflatoxin refers to four different types of mycotoxins produced, which are B1, B2, G1, and G2. Aflatoxin B1, the most toxic, is a potent carcinogen and has been directly correlated to adverse health effects, such as liver cancer in many animal species. Aflatoxins are largely associated with commodities produced in the tropics and subtropics, such as cotton, peanuts, spices, pistachios, and maize.

Ochratoxin is a mycotoxin that comes in three secondary metabolite forms: A, B, and C. All are produced by Penicillium and Aspergillus species. The three forms differ in that Ochratoxin B (OTB) are a nonchlorinated form of Ochratoxin A (OTA) and that Ochratoxin C (OTC) is an ethyl ester form Ochratoxin A. Aspergillus ochraceus is found as a contaminant of a wide range of commodities including beverages such as beer and wine. Aspergillus carbonarius is the main species found on vine fruit, which releases its toxin during the juice making process. OTA has been labeled as a carcinogen and a nephrotoxin, and has been linked to tumors in the human urinary tract.

Citrinin is a toxin that was first isolated from Penicillium citrinum, but has been identified in over a dozen species of Penicillium and several species of Aspergillus. Some of these species are used to produce human foodstuffs such as cheese (Penicillium camemberti), sake, miso, and soy sauce (Aspergillus oryzae). Citrinin is associated with yellow rice disease in Japan and acts as a nephrotoxin in all animal species tested. Although it is associated with many human foods (wheat, rice, corn, barley, oats, rye, and food colored with Monascus pigment) its full significance for human health is unknown.

Ergot Alkaloids are compounds produced as a toxic mixture of alkaloids in the sclerotia of species of Claviceps, which are common pathogens of various grass species. The ingestion of ergot sclerotia from infected cereals, commonly in the form of bread produced from contaminated flour, cause ergotism, the human disease historically known as St. Anthony's Fire. There are two forms of ergotism: gangrenous, affecting blood supply to extremities, and convulsive, affecting the central nervous system. Modern methods of grain cleaning have significantly reduced ergotism as a human disease, however it is still an important veterinary problem.

Patulin is a toxin produced by the P. expansum, Aspergillus, Penicillium, and Paecilomyces fungal species. P. Expansum is especially associated with a range of moldy fruits and vegetables, in particular rotting apples and figs. It is destroyed by the fermentation process and so is not found in apple beverages, such as cider. Although patulin has not been shown to be carcinogenic, it has been reported to damage the immune system in animals. In 2004, the EU set limits to the concentrations of patulin in food products. They currently stand at 50 µg/kg in all fruit juice concentrations, at 25 µg/kg in solid apple products used for direct consumption, and at 10 µg/kg for children's apple products, including apple juice.

Fumonisins are Fusarium toxins, produced by over 50 species of Fusarium and have a history of infecting the grain of developing cereals such as wheat and maize. The fumonisins, which affect the nervous systems of horses and may cause cancer in rodents; the trichothecenes, which are most strongly associated with chronic and fatal toxic effects in animals and humans; and zearalenone, which is unavoidable in pig feed where it causes zearalenone toxicosis, the inactivation of zearalenone after ingestion is critical in stopping toxicity. Other major types of Fusarium toxins include: beauvercin and enniatins, butenolide, equisetin, and fusarins.

Impact of Mycotoxins emerging from the feed in poultry

Mycotoxins pose a direct health challenges, and this include reduced immune response. It also cause reduced skeletal health and reduced feed intake and reduces nutrient absorption and thereby challenge health. A further problem is excretion of lipids, and leads to malabsorption syndrome. It may leave residues in both meat and eggs. For these reasons Mycotoxin contamination is the most significant problem in poultry production.

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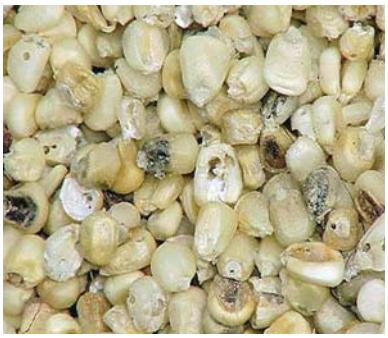
TOXI - SCRUB SYSTEM®

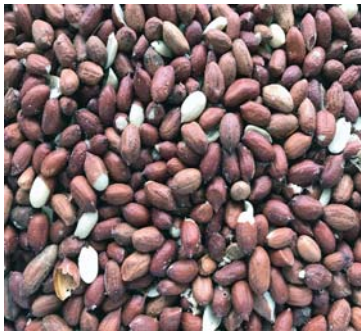
INDUSTRIAL PROCESSING

What can be processed?

Basically the TOXI-SCRUB processing line can be tailored to any product in the Agro, Feed, Cerial supply chain. Including all types of grain, nuts, beans and cakes from the oil seed industry. The Ozon Reactor and the material handeling system may be adjusted to specific requirements. However to make the detoxification process efficient, it is important what material size (especially cake) is supplied in the incomming pit. The iGRAIN laboratory in Copenhagen (Denmark) is able to analyse client samples to suggest the best solutions and also dimention the Reactor Unit to match specific requirements.



Grain:
Contaminated Corn



Nuts:
Contaminated Peanuts

Cake:
Contaminated Peanut Cake

Accessories

In order to supply complete processing line a number of accessories are available, and can be integrated with the processing line:

- Hammer Mill - to break cake before delivery into incomming pit
- Airtight delivery pit – available for sensitive material
- Bagging station with integrated weighing – bags from 5 to 100 Kg available
- Pouch machines – for packing of final consumer products 100, 200, 400 and 100 gram etc.
- Laboratory – we supply a complete laboratory kit to make frequent Mycotoxin tests during Detoxification

All accessories are made in Stainless steel and integrated into complete processing line

Hammer Mill

Pouch Packing Machine

Bagging Machine

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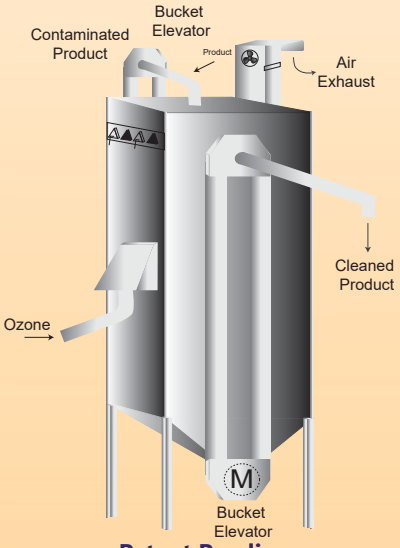
Ozone Generator

For the TOXI SCRUB a special Ozone Generator has been developed with special requirements for the application. The core of the system is the genuine design of corona discharge technology in the special Crop-Protector electrode system. The unit can be supplied in different housings to suit different needs. The generator is applying high oltage to generate sufficient power to excite Oxygen to create Ozone. Emphasis is put on the requirement to have a very stable generator so the production flow is never interrupted. Ozone is generated directly from the air supply and a steady flow of cooling water secures the correct generator temperature.



Patent Pending

Ozone Reactor

The iGrain series of TOXI-SCRUB Processing lines all include the Patent Pending. Reactor developed by Crop-Protector. Inside the reactor the detoxification process is reducing the unwanted Mycotoxins.The advantage of the design is that all Mycotoxins and Fumonisins with a chemical structure with double bonds will be attacked and reduced. In theory the degree of reduction is proportional primarily with the processing time. The entire process is monitored and controlled by the iGrain PLC based System and SCADA (Software Control And Data Acqusition system).
TOXI-SCRUB machines can be tailored to meet clients requirement for efficient “scrubbing” of toxines. Normally the standard models are sufficient for the application. The exact capacity of a “Scrubber” is dependent on the degree of contamination and the size of the material in a specific application.

Consult with our Experts

Before investing in a Toxi Scrubber it is always good to have samples examined in our laboratory. We can test for more than 10 different toxines, and evaluate which treatment/capacity is required for your requirement. We also work together with the Technical University of Copenhagen (DTU). They have an advanced HPLC-MS analyser. This means we can analyse a given sample for all Mycotoxins and Fumonisins in one test, both qualitatively and quantitatively. This is a helpful tool when evaluating investment opportunities. We also assist you in calculating the feasibility of a production line. Normally the pay-back time is less than one year for the simple reason that the material treated have a very low value before treatment and a high value after treatment. Since we include bagging and packing option, including MAP packing, makes the investment more attractive because correct packaging secures a long lasting quality of products.

Please do not hesitate to contact us at info@i-grain.net with your particular requirements. We have the know- how to assist you, no matter how complex your tasks are.

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