



## CONSIDERATIONS REGARDING THE IMPORTANCE OF USING OPTICAL SEED SORTING MACHINES

<sup>1</sup>INMA Bucharest – National Institute for Research–Development of Machines and Installations designed for Agriculture and Food Industry, ROMANIA

<sup>2</sup>Politehnica University of Bucharest, Faculty of Energy, Bucharest, ROMANIA

<sup>3</sup>National Research and Development Institute for Food Bioresources – IBA Bucharest, ROMANIA

**Abstract:** In the preparation and storage of grains, seed cleaning is a highly important phase. There has been extensive research regarding the cleaning and classifying grains. The grain seeds are usually contaminated right from the harvest with the seeds from other plants, with other materials (soil, plant residues, etc.) or even with their own degraded seeds. Since they are the same size and weight, they are difficult to be sorted mechanically. The degree of seed purity may be significantly increased by optical sorting after dedusting and mechanical sorting. The separation of seed mixtures by colour is achieved by using photoelectric devices, which, being sensitive to differences in the intensity of the reflected light beam, emit pulses that are used to carry out orders to separate the seeds of the wrong color. This article emphasizes the importance of introducing new or innovative methods in the seed separation process, especially optical systems. Various ways of sorting were discussed, the design of super interesting sorting systems.

**Keywords:** separation efficiency; optical sorting

### INTRODUCTION

One of the most significant subsectors of the agricultural processing sector is food production. The goals of contemporary agriculture include obtaining higher yields and better crop quality (Nenciu, F et al. 2022). The agri-food industry has likewise seen similar developments for many years. In the preparation and storage of grains, seed cleaning is a highly important phase. There has been extensive research regarding the cleaning and classifying grains (Mircea et al. 2014, Yuan J. et al., 2018, and Krzysiak Z. et al., 2020). Effective seed mixture separation must be based on the characteristics of mixture components that lend themselves to separation, which have been studied by several authors.

Recently, colour sorters have begun to be installed in both wheat flour mills and durum grain mills. Ergot wheat, black tip, fusarium, charred, other discoloured grains, and other internal impurities are removed from wheat using colour sorters during the cleaning process (Inamdar, A., et al. 2014). (Kunhimohammed C.K. et al. 2015) proposed an automatic machine that sorted color using a special color sensor that was TCS230 and PIC microcontroller.

Under these conditions, a colour sensor was used for detection and identification, and the complete procedure was managed by a PIC16F628A microcontroller. Furthermore, the product was evaluated and divided into sections as needed with the use of two conveyor belts. The results showed a precise quality and a higher rate of production in the area of automation.

Kex Technology et al. [12] represented food processing solutions through digital sorting. Various ways of sorting were discussed, the design of super interesting sorting systems. Supplier, receiver, testing, announcing, and globally performed. Selin Macwan et al. [2] introduced a machine using IOT which sorted color.

As per different analyses of objects or pieces such as color, weight, size, and shape, they formulated a way of color sorting of objects using the TCS3200 sensor along with motors and Arduino. Meanwhile, the GSM technique was also performed. Keeping average time consumption before and after contact, a maximum and minimum speed of conveyor belt, blow distances of flow through nozzles productivity, precision, and accuracy of object color sorting was tested.

Other research studies are oriented towards upgrading optic equipment using IOT (Macwan, S., et al. 2018). As per different analyses of objects or seeds such as colour, weight, size, and shape, they formulated a methodology of colour sorting of objects using the TCS3200 sensor. Dumanay, A.B., et al. (2016) represented a newly designed equipment which processed coloured image of olive fruits using an optic sorting technique, while Inamdar A., et al. (2014) proposed the application of optic sorting into wheat milling. Wheat cleaning was performed by removing egret wheat, fusarium, black tip. (Halder, S., et al. 2014) proposed a sorting machine using two ladders development on belt conveyor.

Colour sensor, microcontroller, servo motors, programming helps in the accumulation of data and commands further to operate accurately. (Sheth, S.M., et al. 2010) proposed

automatic sorting system using machine vision. Microcontroller and sorters are used for colour inspection and finally performed using machine vision. Algorithm are calculated using MATLAB software.

(Sachdeva, A., et al. 2017) introduced counting and color sorting machine to developed industrial automation using a nano microcontroller and color sensor of type TCS3200. Various techniques such as optical sensors, sets of inductive, and capacitive are going on nowadays resulted in saving money and time (Chatte, U.A., et al. 2018). (Shen, L.J., et al. 2015) introduced the development and designing of the robot which sorted colors. With the advancement in technology, applications are started widening using the new approach. (Jaisingpure, P.S., et al. 2017) introduced automated object sorting based on colour detection in which USB camera is used for detection purpose and raspbian operating system (Raspberry Pi 2) functioned as automated sorter. Saurin Mukundbhai Sheth et al. [16] proposed automatic sorting system using machine vision. Microcontroller and sorters are used for color inspection and finally performed using machine vision. Algorithm are calculated using MATLAB software.

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#### **MATERIALS AND METHODS**

The separation of seed mixtures by colour is achieved by using photoelectric devices, which, being sensitive to differences in the intensity of the reflected light beam, emit pulses that are used to carry out orders to separate the seeds of the wrong color. When a seed passes between the photoelectric cell and the screen, it intercepts the light rays reflected by the screen.

If the seed has the same color as the screen, the light reflected by the seed in the direction of the photoelectric cell has the same intensity, and the current emitted by the photocell remains the same. If the seed has a different color than the screen, then the photocell is impressed differently and emits an electric current of a different intensity. In this way, the color differences are transformed into electrical impulses of different intensity that act on the separation device which, usually through a jet of compressed air, diverts the seeds of different color from the path of the seed row.

In order for the separation to be of quality, it is necessary for the seeds to pass one by one through the space

between the screen and the photocell. For this purpose, the machines that work on this principle have organs for ordering the seeds in a row.

Usually, seed color detection cameras are equipped with several channels working in parallel. In these conditions, the seeds are observed on all sides. The organs that execute the separation

#### **RESULTS**

The sorting machines produced by SEA (figure 1) are equipped with both front and rear cameras, so that both sides of the seed are examined. Seeds or impurities that have a different color than normal are deflected from their normal fall path with the help of a jet of air. Along with the elimination of unhealthy elements, good grains can also be eliminated, which can be recovered to a good extent by a new pass.

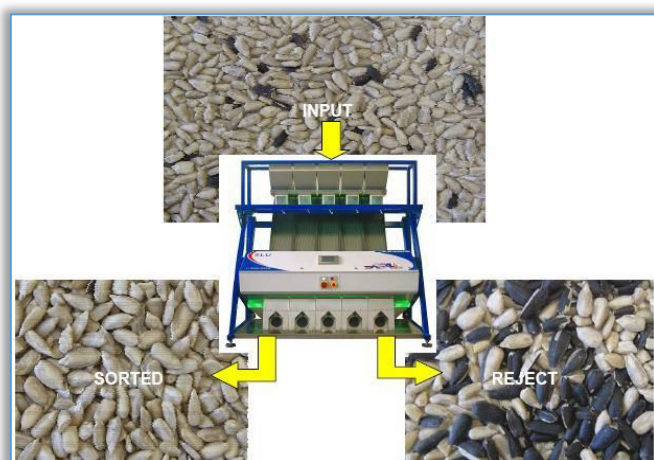


Figure 1 – The principle of operation of the optical seed sorting equipment, SEA (www.geangu.ro; www.cimbria.ro)

The machines are modular, they can have from one to five channels. In the case of machines with more than one channel, an automatic passage of the material rejected by the first channels can be designed through the channel or channels prepared for this purpose. In the course of time, the machines were always perfected.

To eliminate, for example, black sclerotia from black sunflower seeds, the machines were equipped with an infrared ray system. For a better examination, the resolution has been increased and the lighting with

fluorescent tubes has been replaced with lighting produced by red, green and blue LEDs. Through the different combination of the three colors, various other intermediate colors can be obtained to be used for each individual case. This new version is called Pixel NEXT, it can have up to 7 channels and can sort 35 tons/hour of wheat. For each individual material the productivity is different. The operating principle of a sorting equipment: 1 Input product is loaded into the in-feed hopper, 2 it moves along the vibrating plate 3 until it flows on to a sloping chute where it is individually checked and sorted by state-of-the-art cameras 4 (CCD cameras for standard version and 5 additional cameras for bichromatic, NIR and InGaAs versions) situated in the front and rear of the flow. 6 Depending on the signals received by the optical device, the sorter software controls the pneumatic device, 7 which physically separates the unwanted products out of the conforming ones which naturally reach their discharging hopper. 8 The rejected products are instead deviated by a jet of compressed air produced by the relevant ejector and discharged in the front side hopper. In automatic re-pass versions, the sorted or rejected product is automatically conveyed to another section of the machine for undergoing an identical process.

Table 1. Possible configurations

Model	Next 1	Next 1,5	Next 2	Next 3	Next 4	Next 5	Next 6	Next 7
Vibrator	1	2	2	3	4	5	6	7
Chute	1	2	2	3	4	5	6	7
CCD cameras	2 to 4	2 to 4	4 to 8	6 to 12	8 to 16	10 to 20	12 to 24	14 to 28
Ejectors	54	77	108	162	216	270	324	378
Width	1560	920	1560	1560	1950	1950	2540	2540
Depth	1550	1715	1550	1550	1550	1550	1550	1550
Height	2100	2100	2100	2100	2100	2100	2100	2100
Weight	600	650	700	800	850	950	1.100	1.200
Power cons.	1,5	1,5	1,5	1,5	2,5	2,5	3,5	3,5
Air cons at 4 bar	8,4	12,6	16,8	25,2	33,6	42,0	50,4	58,8

GROTECH manufactures high-end optical seed sorting machines of the ZF series (figure 2), capable of well sorting different products, such as rice and wheat.



Figure 2 – ZF series multi-function colour sorting machine  
(www.grotechcolorsorter.com)

Table 2. Parameter Table

Model	ZF700
Optimized Carryover (Bad : Good)	30:1
Product output(t/h)	3.0–8.0
Heating of tray	YES
Camera	CCD
Type of selection	Per size/color
Remote Access&Control (connectivity)	YES
Channel split	N/A
Net Weight (kg)	1665
Europe Certification	Type of illumination
Power consumption(kw)	3.5
Dimension LxWxH(mm)	3030*1658*1850
Power supply(V/HZ)	220V±10% 50/60HZ

Multifunction color sorting advantage:

- high reliability – excellent anti-interference ability;
- high precision – support high-end processing algorithms such as artificial intelligence and neural network;
- high consistency – using the most advanced assembly technology and calibration technology on the market to ensure the consistency of the whole machine and channels.

Multifunction color sorting application: the high level ZF series multi-function color sorter machine able to sorting different products well with one machine.

## CONCLUSIONS

The main purpose of seed conditioning is to improve seed quality by removing impurities (broken seeds, chaff, weed seeds, plant debris, etc.).

Optical seed sorting machines have the ability to check each seed and identify possible defects that may affect the germination or vigor of future plants and automatically eliminate those with defects.

Optical sorters can recognize the color, size, shape, structural properties and chemical composition of objects. Compared to manual sorting, which is subjective and inconsistent, optical sorting helps improve product quality, maximize yield and increase yields while reducing labor costs.

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Faculty of Engineering Hunedoara,  
5, Revolutiei, 331128, Hunedoara, ROMANIA  
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