

# Foreign Body Prevention Strategies

**Robert Rogers – Mettler Toledo**

Senior Advisor for Food Safety & Regulations

**Deb Smith – Vikan**

Global Hygiene Specialist

METTLER TOLEDO



# Webinar Housekeeping

- ❑ The presentation will last about 45 minutes.
- ❑ After the presentation, there will be a 10-15 minute Q&A session. You are invited to send your questions via the Q&A box provided.
- ❑ We will reach out after the webinar to answer any questions we do not address during the session.
- ❑ This webinar is being recorded and we will send you the recording a few days after the live event.



# About our presenters



Robert Rogers

Senior Advisor – Food  
Safety & Regulation,  
Mettler Toledo



Deb Smith

Global Hygiene Specialist,  
Vikan

# About Vikan and Remco



Leading provider of advanced hygiene and cleaning products and solutions for key sectors, with a global presence in over 90 countries.



Supplies color-coded sanitation and material handling tools for the food industry in North America.

Remco is Vikan's dedicated presence in North America (U.S. and Canada).

For more information, visit us at:

- <https://remcoproducts.com/us/about-remco/who-we-are>
- <https://www.vikan.com/int/about-vikan/who-we-are>

# METTLER TOLEDO at a Glance

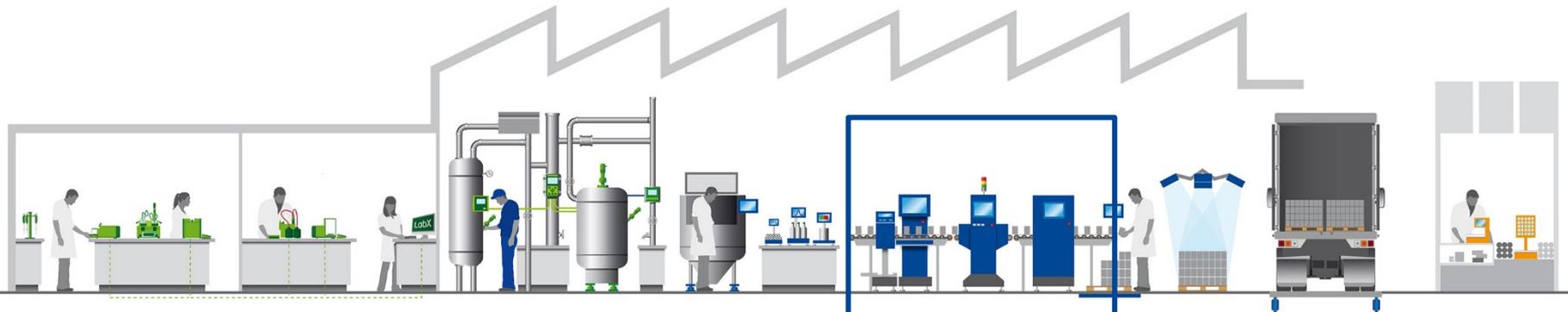
METTLER TOLEDO

**METTLER TOLEDO is a leading global manufacturer and marketer of precision instruments and services for use in laboratories and manufacturing.**

- 18,000 employees
- \$3.9 billion turnover
- Sales organizations in 40 countries



See our Corporate Responsibility Report  
[www.mt.com/sustainability](http://www.mt.com/sustainability)



Laboratory Solutions

Process  
Analytics

Industrial  
Weighing

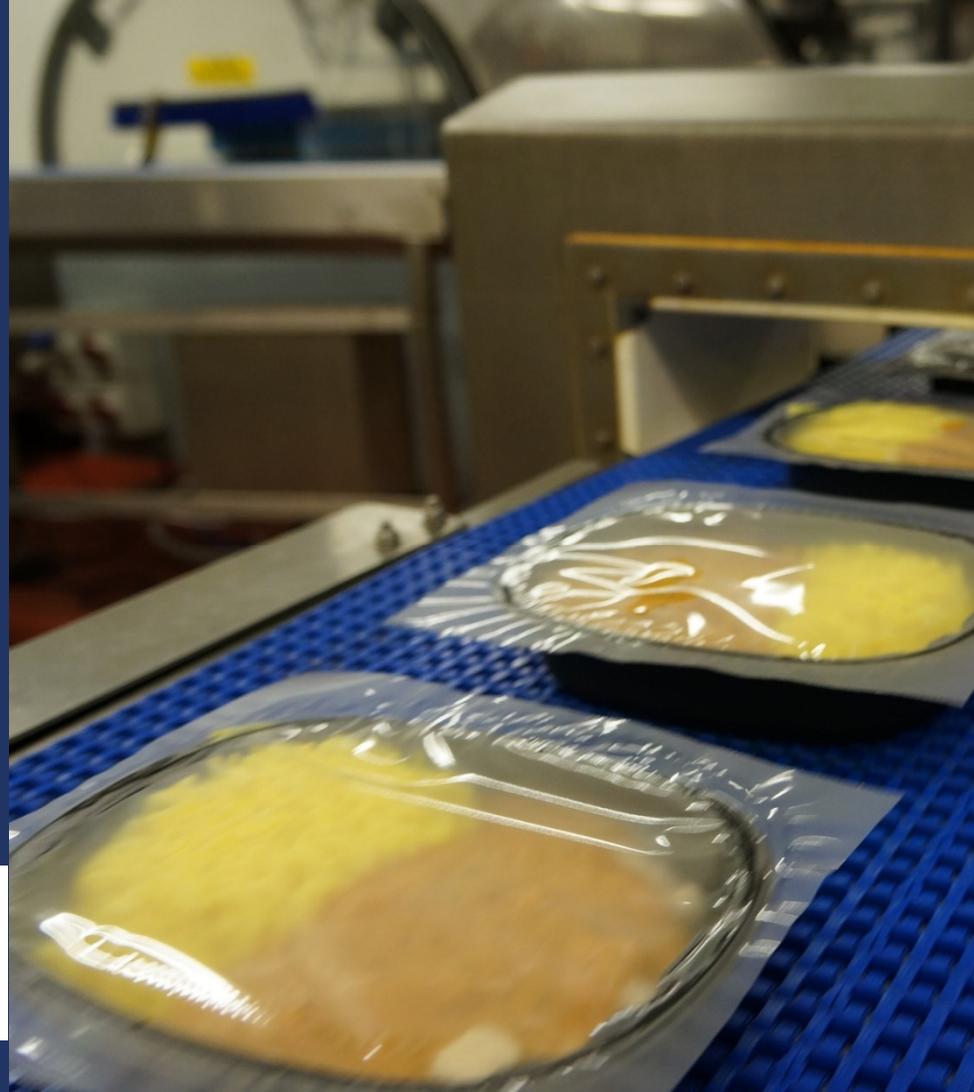
Product  
Inspection

Logistics  
Solutions

Retail  
Weighing  
Solutions

# Foreign Body Prevention Strategies

METTLER TOLEDO



Robert Rogers  
Sr. Advisor Food Safety & Regulation



# Metal Detection, X-Ray Inspection or Both

Principles of Operation

METTLER TOLEDO





## Regulatory

- Specific to Manufacture and Point of Sale location
- Nonprescriptive
- Required
- Penalties – Fines - Jail



## 3<sup>rd</sup> Party Programs

- Globally Accepted
- Provides Entry to Market
- Various Program Options
- Assessment - Audit



## Customer Programs

- Prescriptive
- Brand Protection
- Co-Packing

## Regulatory Guidance

- 7mm (FDA CPG 555.425)
- 25mm(L) ((FDA CPG 555.425)
- 2mm (Health Canada. Field Compliance Guide 90-2)

## Regulation

- If it consists in whole or in part of any filthy, putrid, or decomposed substance, or if it is otherwise unfit for food; or if it has been prepared, packed, or held under insanitary conditions whereby it may have become contaminated with filth (21 U.S.C. 342(a)(3)(4))
- No person shall sell an article of food that has in or on it any poisonous or harmful substances (Food and Drugs Act Section(4)(a))

Production & Filling

Packaging

Logistics



**Metal  
Detection**



**X-ray  
Inspection**



**Vision Inspection**

A<sub>s</sub>

L<sub>ow</sub>

A<sub>s</sub>

R<sub>easonably</sub>

A<sub>chievable</sub>



Metal Detection

X-Ray Inspection

## Detection systems for every application



### Conveyorized

- All sectors
- Bulk, unpacked and wrapped foods



### Gravity Fall

- Flour
- Grains
- Powders



### Throats

- Potato chips
- Confectionary



### Pipeline

- Soups, sauces, baby food
- Pumped sausage meat



### Pharma

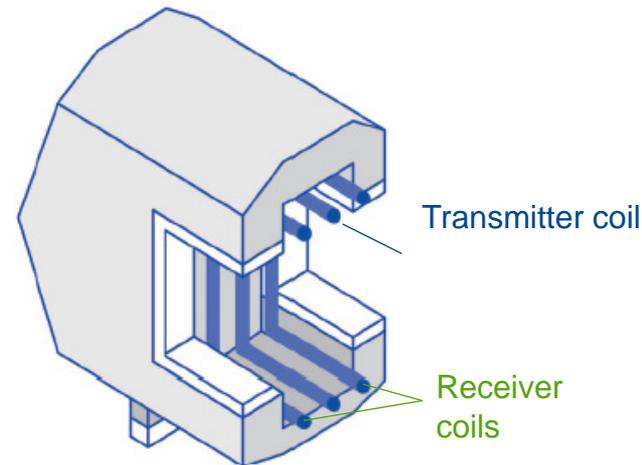
- Tablets
- Capsules
- Powders



## Based on magnetic permeability & electrical conductivity

### Balanced coil design

- 3 coils wound around a supporting frame
- Creates an electromagnetic field
- Field is disturbed when metal passes through it



Modern metal detectors can identify all metal types

**Best performance requires:**

Maximum sensitivity + Stability + Reliability (0 false rejects)

## WHAT IS SENSITIVITY?

**Sensitivity** is the measure of a metal detector's ability to detect a specific type and size of metal contaminant. The better the sensitivity of the metal detector, the smaller the pieces of irregular-shaped metal it can detect. When measuring the sensitivity of a metal detector, a test piece must be reliably detectable when passed through the center of the aperture.



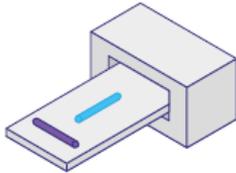
Metal Type



Packaging Material



Process Speed



Orientation Effect



Environmental Conditions



Detector Frequency



Aperture Size and Product Position



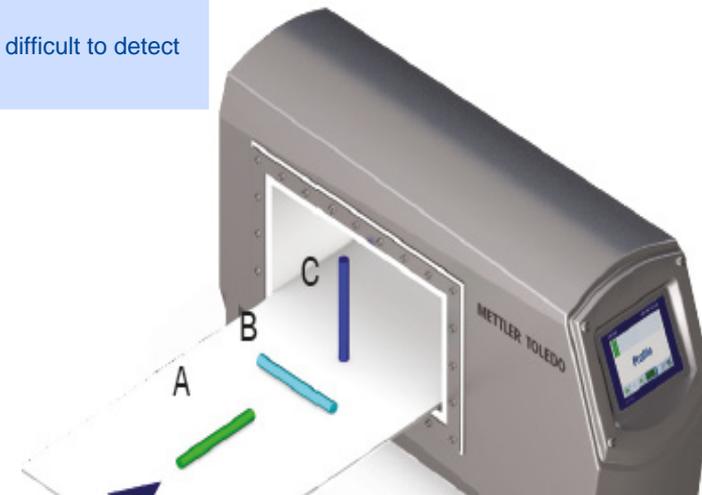
Product Characteristics

## Relative Ease of Detection Based on Characteristics of Different Metal Types

Product Characteristics	Ferrous	Non-Ferrous	Stainless Steel
Magnetic Permeability	Magnetic	Non-magnetic	Usually non-magnetic
Electrical Conductivity	Good electrical conductor	Generally good or excellent	Usually poor conductors
Ease of Detection	Relatively easy to detect	Relatively easy to detect in dry applications Harder to detect in wet applications	Relatively difficult to detect

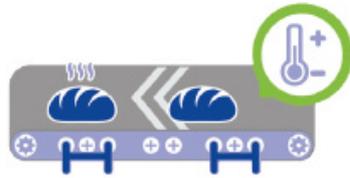
## Relative Ease of Detection Based on Contaminant's Orientation

Position	Ferrous	Non-Ferrous	Stainless Steel
A	Easy	Difficult	Difficult
B	Difficult	Easy	Easy
C	Difficult	Easy	Easy

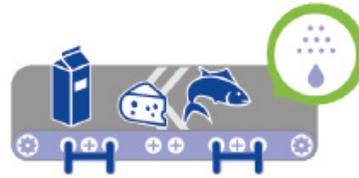


## Product effect can lead to high false reject rates

- Product effect occurs when a product's own characteristics inhibit the inspection device's ability to distinguish between the product being inspected and a particular contaminant type.
  - Challenging applications can result in potentially high false reject rates, unless the technology in use is able to overcome product effect



**1** Product temperature



**2** Moisture or salt content



**3** Product format



**4** Product consistency



**5** Orientation on the production line



**6** Product size and shape

## Not all metal detectors are created equal for every application



**'Dry' Applications**  
No product effect impacts



Use ultra-high tuned frequency  
detection technology

Low product effect allows higher  
achievable sensitivities



**'Wet' Applications**  
Where product has high salt or  
moisture content, variable  
temperature, or is packed in metallized  
film



Use Multi-Simultaneous Frequency and Product  
Signal Suppression technology to reduce the  
active product signal from wet products\*



High inconsistent product effect requires the  
inspection device to discriminate between  
product effect and contamination signals



## Different types of detection technologies, different capabilities



Detector	Ferrous	Non-Ferrous	Stainless
Single	1.2	1.2	1.8
Dual	<u>1.2</u>	<u>1.2</u>	<u>1.5</u>
Multi-Simultaneous	1.5	1.5	2.0



Detector	Ferrous	Non-Ferrous	Stainless
Single	1.8	2.4	4.5
Dual	1.8	2.2	3.8
Multi-Simultaneous	<u>1.5</u>	<u>1.8</u>	<u>3.2</u>



Metal Detection

X-Ray Inspection

## Choosing the right x-ray for the application – Vertical Systems



■ **Sealed Pack Machines**

■ **Bulk-Flow Machines**

■ **Pipeline Machine**



## Choosing the right x-ray for the application – Vertical Systems



- **Large Case Machines**



- **Loose-Flow Machines**



- **Continuous Pack Machine**



## Choosing the right x-ray for the application – Horizontal Systems



- Low Absorption

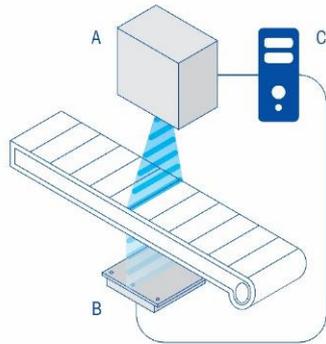


- Medium Absorption Packaging



- High Absorption Packaging

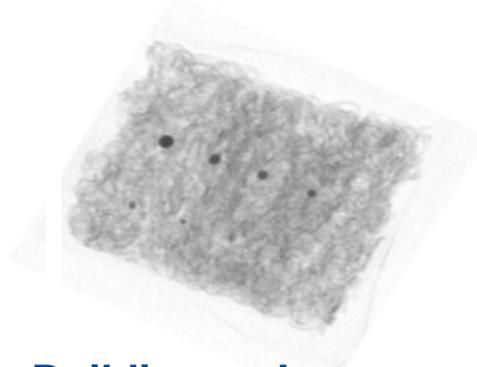




## An X-ray System

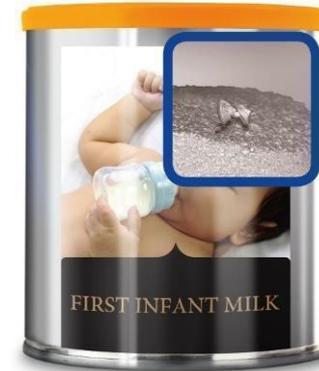
Has three components

- A) X-ray generator
- B) Detector
- C) Control system



## Building an Image

- The x-ray beam is channeled through the product and hits the detector
- The beams are absorbed by the product, with the residual energy reaching the detector
- The differences in absorption is measured, this is how contaminants are found

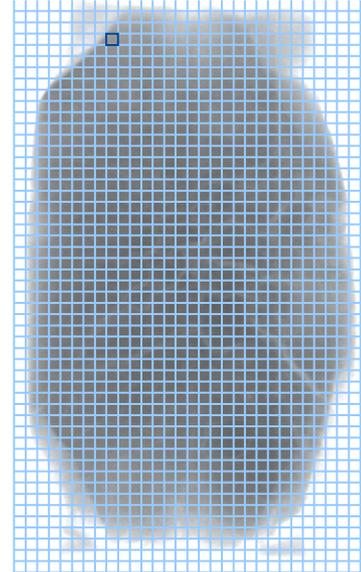


## Contamination Detection

- **Product thickness** (in the direction of the x-ray beam)
- **Product density** to x-rays (e.g. soup is more dense than cereal)
- **Contaminant size and density** to x-rays (e.g. metal is more dense than glass)

## X-ray Detector

The x-ray image is created by the residual energy hitting the detector diodes. These convert the level of x-ray dose into electrical signals and pass these to the on-board computer for analysis.

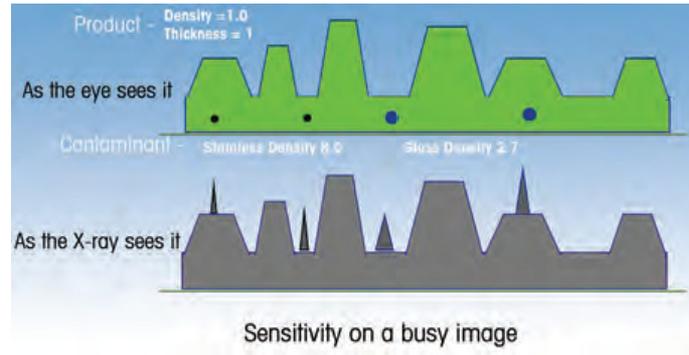
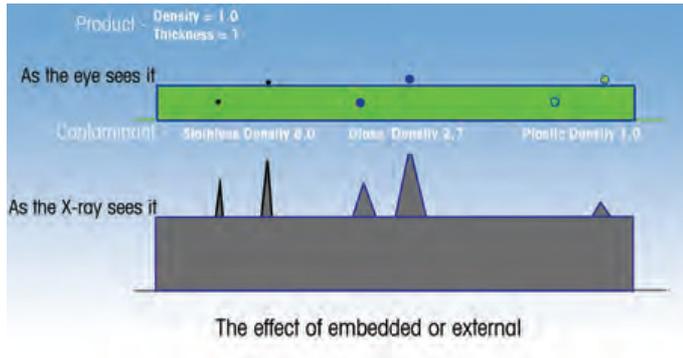


## X-ray Absorption Principles

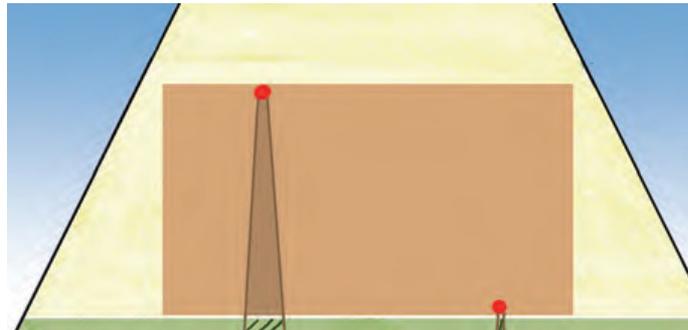
	Typical Food Contaminant	Typical Density g/cm <sup>3</sup>	Detectability
	Wood, stalks, insects, fruit stones	0.7	Typically not detectable
	Low density plastics	0.9 - 1.2	
	<b>Water (reference)</b>	<b>1.0</b>	<b>Typical food density</b>
	Dense rubber, bone, agglomerates	2.5	Detectable in sizes typically >3mm
	Glass ('low mineral'), ceramics	2.5	
	Aluminium	2.7	Detectable in sizes typically >2mm
	Mineral stone, dense plastics	3.0	Detectable in sizes typically >0.5mm depending on material and product
	Glass ('high mineral')	6.0	
	Non-ferrous metal	7.5	
	Ferrous metal and stainless steel	7.5 - 8.0	
	Lead	11.30	
	Gold	19.30	

**If the contaminant floats on water it is not detectable**

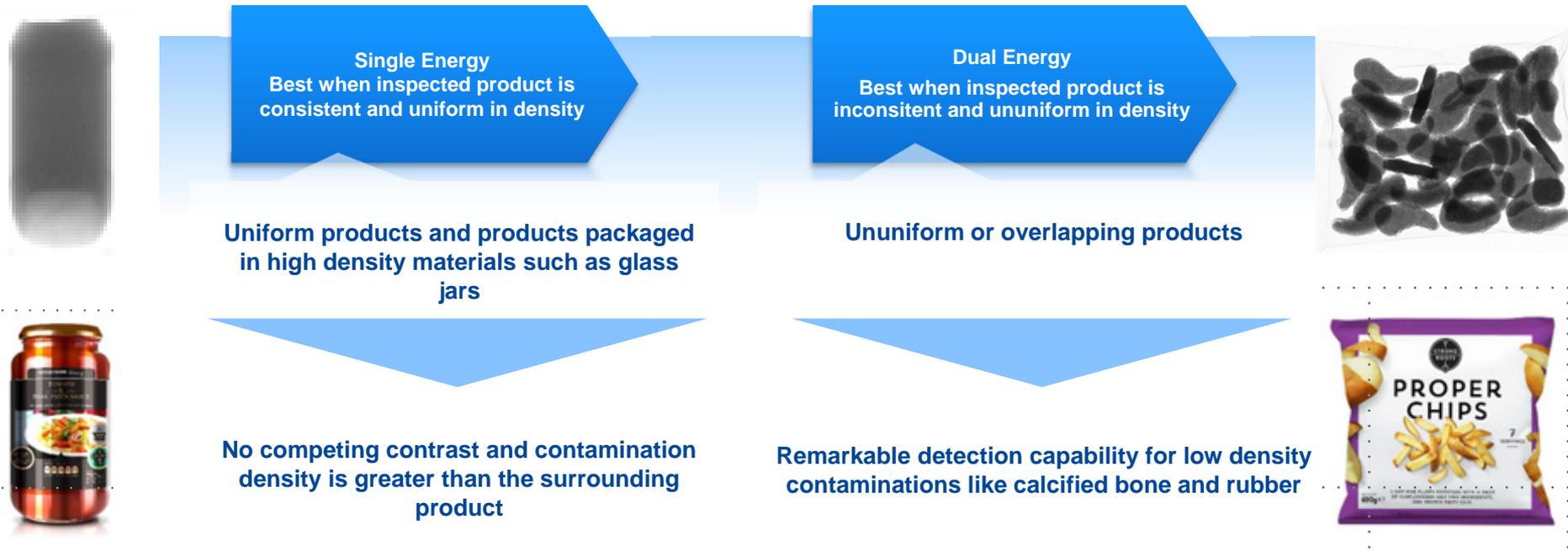
## Product Effect

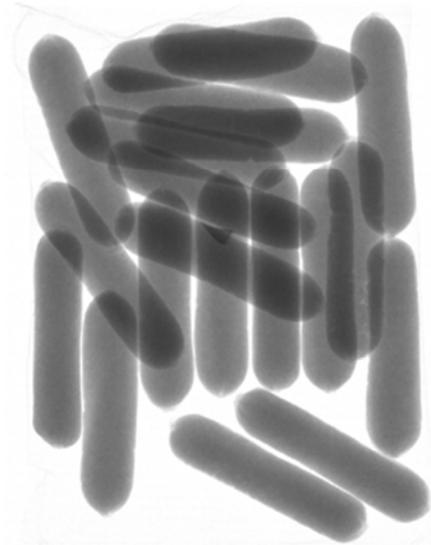


## Position in X-Ray Beam



## Not all X-Rays are created equal for every application





**Conventional X-Ray Image**



**DXD Technology**



**DXD+ Technology**



## Inspection tools ensure high quality products

Avoiding:

- Missing items
- Over or under filling
- Incorrect mass
- Product and packaging defects

## Beyond Product Safety

- Ensure consistent product mass
- Confirm products have no missing or partial items
- Protect product's integrity
- Minimize product waste
- Ensure consistent product quality

## Metal detection and x-ray inspection offer differing capabilities

### Metal detection may be the best choice when:

- Metal is the only likely foreign body contaminant risk
- Aluminum has been identified as a potential risk
- Product must be inspected under gravity-fed conditions, including VFFS applications
- There is a need to protect expensive downstream equipment from metal contaminants

### X-ray inspection may be the best choice when:

- Non-metallic contaminants such as glass, mineral stone, calcified bone, or high density rubber or plastics are identified as the contaminant risks
- Product is in metal packaging
- Additional product and packaging checks are required, such as mass measurement, checking for missing or broken products, product in seal inspection or fill level checks

### When Both Solutions Should Be Considered

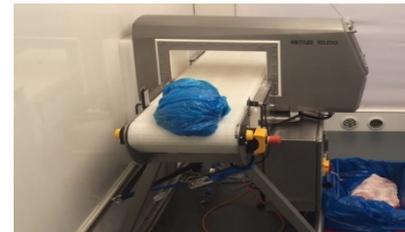
- Different foreign body risks are identified at different CCPs
- Retailer contracts require both
- To achieve peace of mind that all precautionary steps have been taken to minimize the risk of foreign body contamination

### Note

**Product testing prior to purchase is highly recommended to establish achievable sensitivity.**



## Helping our customers further to make the right choice



### On-site Product Demo

We can bring our demo vehicle to you\*, so you can put our metal detector to the test and compare results against your current metal detector performance.

\*Availability varies by country

### eDemo

- Product presentation
- Show specific machine functions
- To demonstrate software & solutions
- Demostarte product tests
- Conduct FAT
- Training for Customers

### Product Testing

We offer **FREE** product testing at our Global test facilities supported by a full product test report on your individual product(s).

## Reliable Product Inspection Plus One-stop Shopping



**Product Inspection Solutions Guide**  
Discover how METTLER TOLEDO's product inspection solutions can help improve product quality and efficiency on your production line.

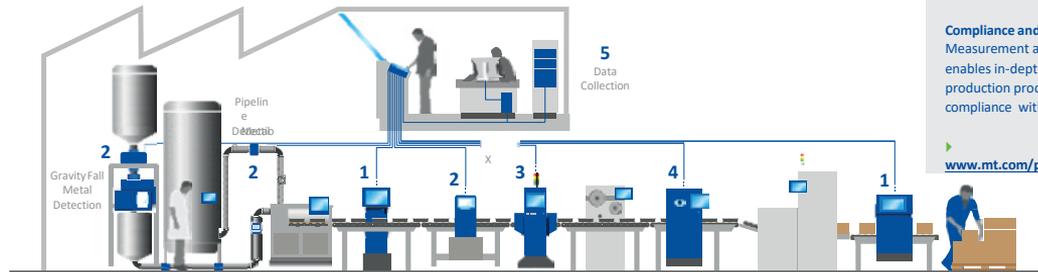
▶ [www.mt.com/pi-pocketguide](http://www.mt.com/pi-pocketguide)



5

**Compliance and Productivity**  
Measurement and recording of inspection data enables in-depth analysis and improvement of production processes while ensuring compliance with industry standards.

▶ [www.mt.com/prodx](http://www.mt.com/prodx)



Raw Material  
Storage &  
Processing

Filling &  
Primary  
Packaging

Inline  
Checkweighing

Conveyorized  
Metal  
Detection

X-ray  
Inspection

Labelling

Vision  
Inspection

Secondary  
Packaging

Case  
Checkweighing

**METTLER TOLEDO Service**

Full Life-Cycle Support for Inspection Equipment

1



**100% Weight Control**  
Inline checkweighers ensure every package is checked for compliance with Weights & Measures and industry regulations.  
▶ [www.mt.com/checkweighing](http://www.mt.com/checkweighing)

2



**Metal Contaminant Free**  
Inspection technology for improved productivity ensuring the removal of metal contaminants to meet compliance needs.  
▶ [www.mt.com/metal-detection](http://www.mt.com/metal-detection)

3



**Contaminant Detection and Integrity**  
X-ray inspection ensures freedom from physical contaminants while checking package fill levels and integrity.  
▶ [www.mt.com/xray-inspection](http://www.mt.com/xray-inspection)

4

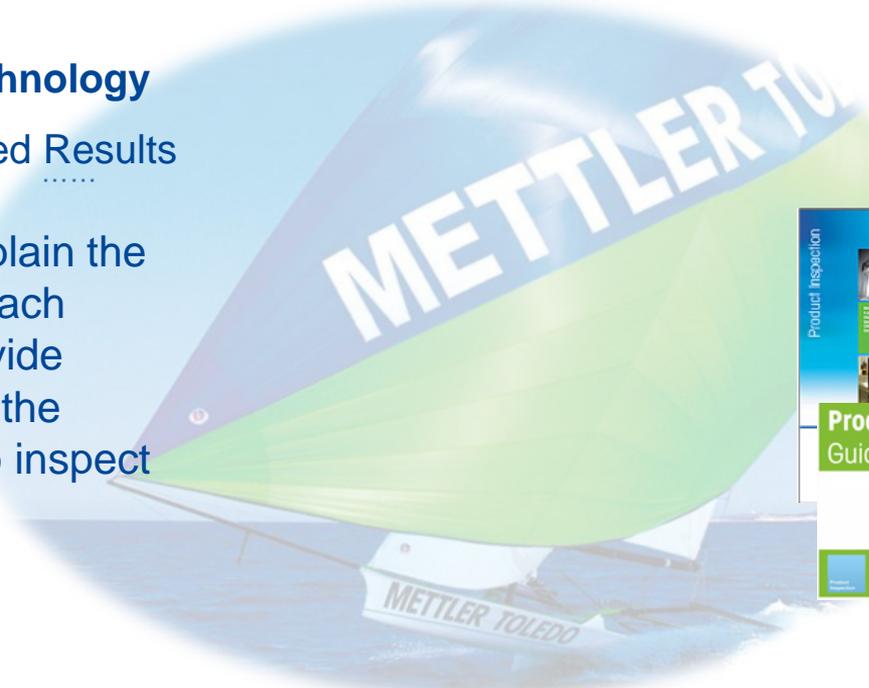


**Fully Compliant Labelling**  
Vision technology checks product label presence, positioning and contents as well as package quality and integrity.  
▶ [www.mt.com/vision-inspection](http://www.mt.com/vision-inspection)

## Using the Right Technology

To Achieve the Desired Results

**Free** downloads explain the basic principles of each technology and provide support in selecting the optimum systems to inspect your products.



For more information visit

[www.mt.com](http://www.mt.com)

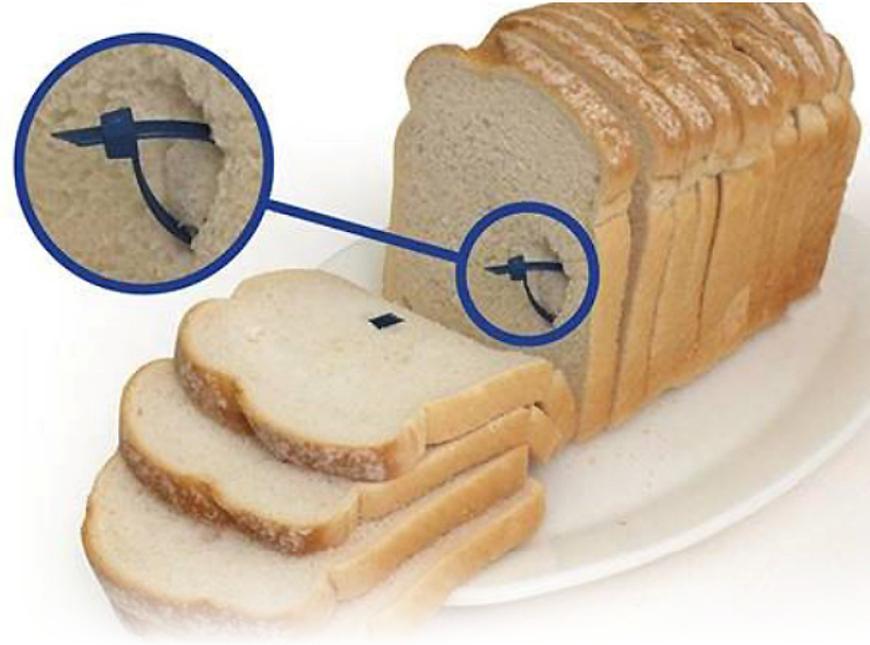
# Control of plastic foreign bodies in the food industry

Deb Smith  
Global Hygiene Specialist



# Why control foreign bodies in food?

- Brand/business protection
- Food safety and quality
  - HACCP - identify hazards, assess risk, implement control measures
- Legal requirement
  - EU & UK
- Audit requirements
  - GFSI recognised schemes



# EU & UK Foreign Body Regulatory Requirements

European legislation:

- *EU Regulation 178/2002: laying down the general principles and requirements of food law, establishing the European Food Safety Authority and procedures in matters of food safety 852/2004 (and associated regulations): on the hygiene of foodstuffs*

Requires that food complies with various hygiene regulations specifying that food must be safe. All potential hazards must be **eliminated or reduced to an acceptable level**.

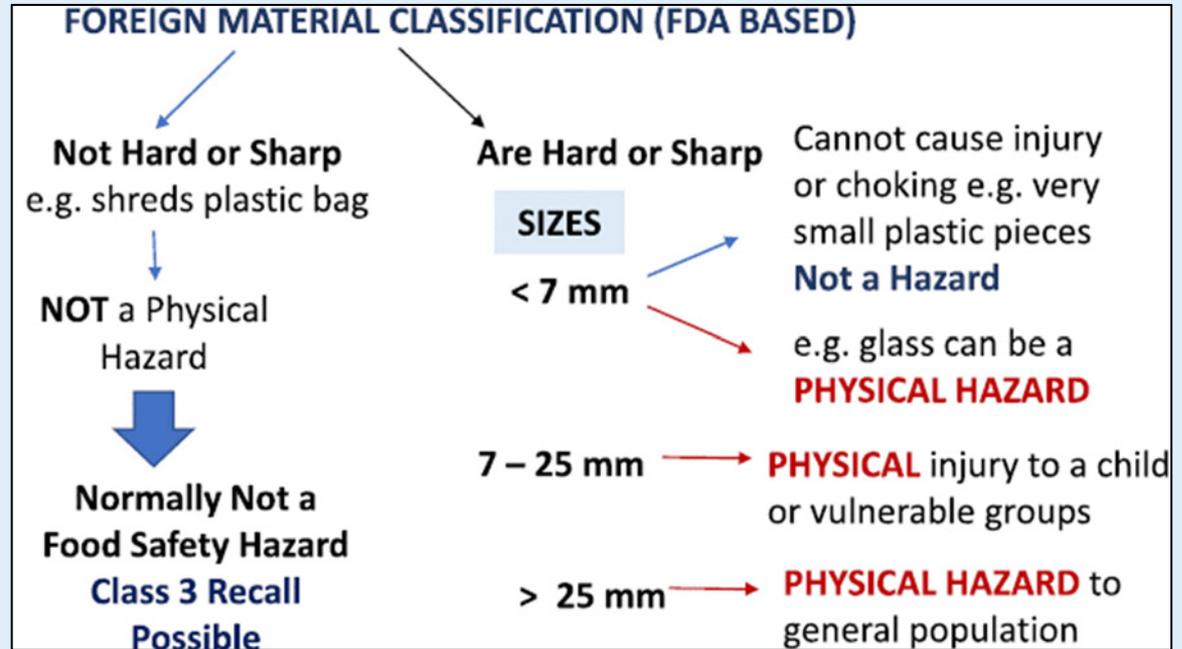
UK legislation:

- *Food Safety Act 1990*
- *General Food Regulations 2004*

Concept of 'due diligence' - allows a manufacturer or seller must be able to **demonstrate that they have done as much as is 'reasonably practicable'** to prevent the contamination.

# Foreign body size

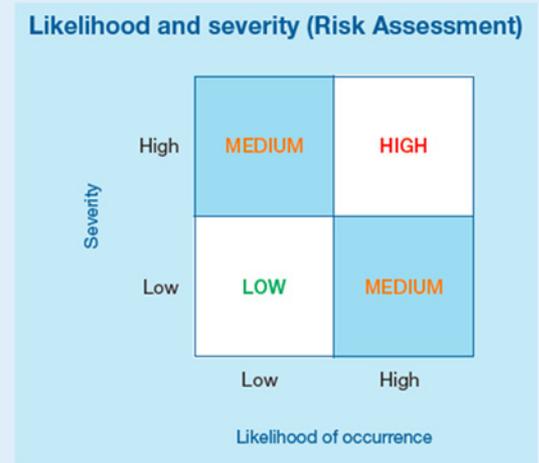
No EU or UK defined size for foreign bodies!



# Foreign body control: GFSI Schemes

## Overall approach

- Supplier & raw material approval & monitoring
- Equipment selection
- Personnel hygiene
- Buildings & equipment cleaning & maintenance
- Foreign body detection & removal
- Audit, corrective action, root cause analysis
- Document procedures



# Foreign body detection systems: GFSI Schemes



FSSC 22000, v6

2.5.11 Hazard control and measures for preventing cross-contamination (all food chain categories, excluding FII)

d) i. The organization shall have a **risk assessment** in place to determine the need and type of foreign body detection equipment required. Where the organization deems no foreign body detection equipment is necessary, justification shall be maintained as documented information



Global Standard: Food Safety, v9

4.10 Foreign-body detection and removal equipment

4.10.11. A **documented assessment** in association with the food safety plan shall be carried out on each production process to identify the potential use of equipment to detect or remove foreign body contamination.



# Foreign body detection systems: GFSI Schemes



IFS Food, v8

4.12 Foreign material risk mitigation

4.12.1 Based on **hazard analysis and assessment of associated risk**, procedure(s) shall be in place, and be documented, implemented, and maintained to prevent contamination with foreign materials.



SQF Food Safety Code: Food Manufacturing, v9

Detection of foreign objects

11.7.4.2 Where detection and/or removal systems are used, the site shall establish limits for detection, **based on a risk assessment** of the product and its packaging, and identify the location(s) of the detector(s) in the process.

# Plastics as foreign body contaminants

**PRODUCT RECALL**

**TESCO**

**Tesco Cottage Pie Baby Food 190G**



We have been made aware that certain date codes of Tesco Cottage Pie Baby Food 190g may contain small pieces of blue plastic

<https://www.food.gov.uk/news-alerts/alert/fsa-prin-35-2021>

**PRODUCT RECALL**

**MORRISONS CHOCO CRACKLES 375G**

**Best Before End 11/2021**



<https://www.food.gov.uk/news-alerts/alert/fsa-prin-22-2021>

**ALDI**

**Product Recall**

**IMPORTANT NOTICE**



<https://www.food.gov.uk/news-alerts/alert/fsa-prin-24-2021>

# Drivers behind the use of metal detectable plastic equipment

## **Chocolates recalled over brush bristles in product**

By News Desk on January 12, 2023

Sanders Candy LLC, doing business as Second Nature Brands, is recalling various chocolate products because of foreign material in the products, specifically pieces of cleaning brush bristles.

The recalled products were distributed nationwide and in Canada. The recall was initiated on Dec. 22, 2022, and is ongoing.

<https://www.foodsafetynews.com/2023/01/chocolates-recalled-over-brush-bristles-in-product/>



# Calibration of metal detectors for metal detection

- Metal detectors are designed to detect METAL
- Manufactures of metal detection equipment provide 'calibration test pieces' to check the function of the metal detector.
- The settings on the metal detector are adjusted until the test piece (containing the type and size of metal ball that needs to be rejected) is rejected when it passes through the detector.



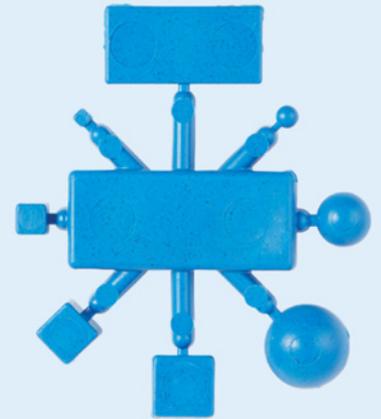
# Calibration of metal detectors for metal detectable plastics

- Essential to calibrate detector to maximise detection of both metal and metal detectable plastics
- It is impossible to calibrate metal detectors to detect both metal AND metal detectable plastic fragments of the same size
- Even the most detectable plastic (in the study illustrated on slide 47) would need to be
  - **7 times** bigger in diameter than a iron sphere i.e., 11mm diam vs 1.5mm diam.

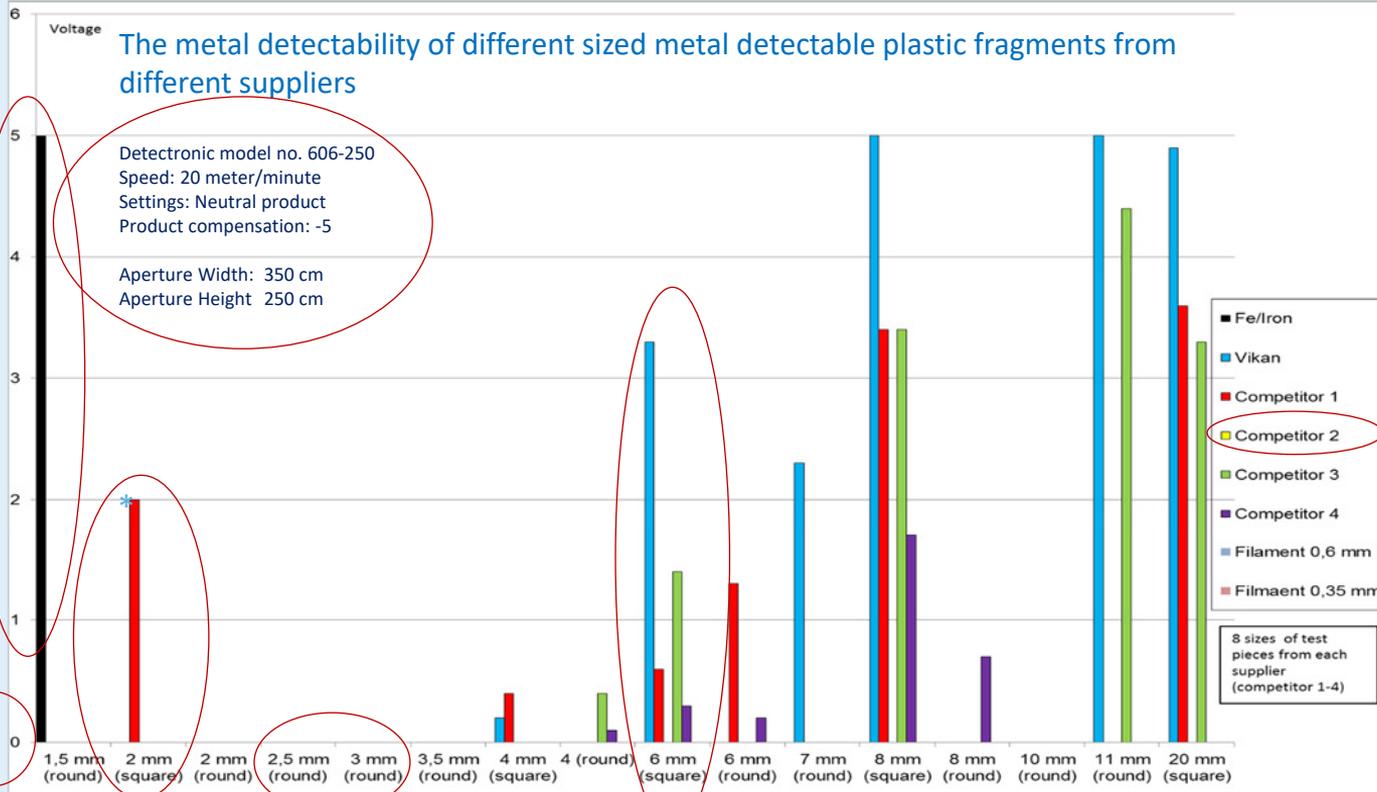


# Calibration of metal detectors for metal detectable plastics

- Metal detectable plastic calibration test pieces can be used in either of the following ways,
  - once the detector has been calibrated for metal detection, the metal detectable plastic calibration pieces can be used to determine the size of metal detectable plastic that will be detected under the same settings
  - If the metal detector is only being used to control metal detectable plastics the test pieces can be used to calibrate the detector to reject the required size of metal detectable plastic fragment



# Detectability of metal detectable plastics

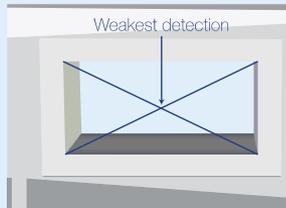
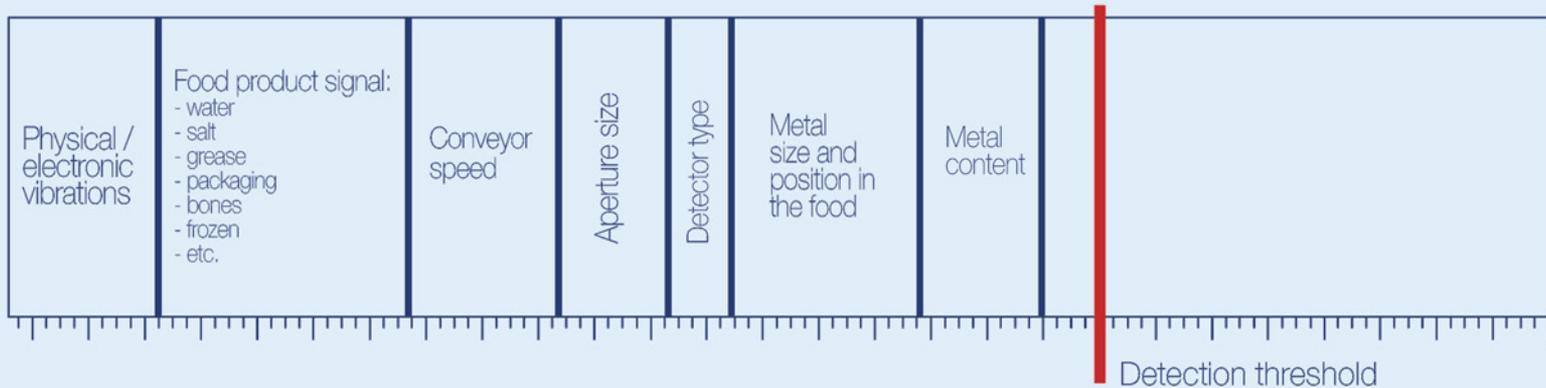


- Even without the additional interferences of product and packaging, the detectability of metal detectable plastics varies enormously.
- Some metal detectable plastics were undetectable.
- Some gave odd results - poor distribution of the metal detectable compound?



# Detectability of metal

➤ Many things can interfere with the detector signal and affect the point of detection.



# Metal detectable brush bristles

- Some cleaning tool manufacturers now supply brushes with metal detectable bristles
- Investigations
  - Are they detectable?
  - Are they durable?



# Detectability

Table 2: Metal detectable bristle detection with and without the presence of food

Independently investigated using a commercial metal detector (Mettler Toledo).

Bristle diameter (mm)	Bristle length (mm)	Bristle orientation		No food/packaging	Packed sugar (dry)	Packed chicken breast (wet)
0.35	100	—		*1.8	N/D	N/D
0.50	100	—		*2.2	N/D	N/D
0.60	100	—		*2.5	N/D	N/D
0.35	50	—		N/D	N/D	N/D
0.50	50	—		*1.8	N/D	N/D
0.60	50	—		*2.3	N/D	N/D

\*Minimum detectability threshold for a 1.5mm diameter sphere of iron = 1.8  
 ND – Not Detected

Conclusion: Metal detectable bristles were not detectable in the presence of food

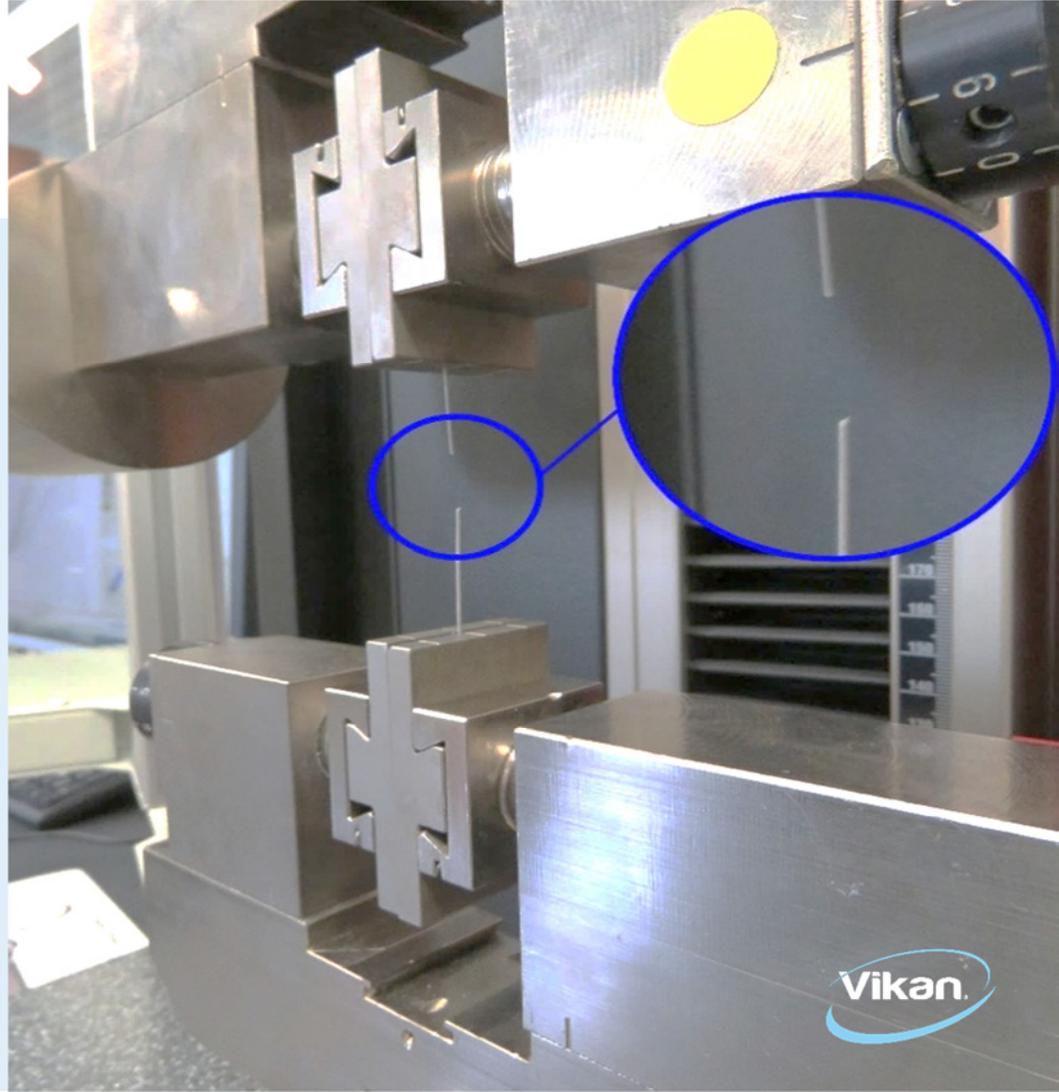


# Durability

Plastic vs metal detectable

- strength
- elasticity

Independent investigation using  
a Zwicki 5kN (Zwick Roell)



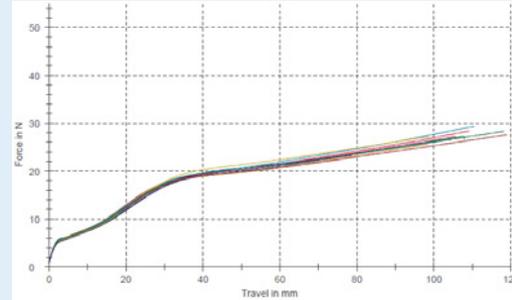
# Durability results

Test data for 0.35 mm diameter plastic and metal detectable bristle break strength and elasticity investigations.

Plastic bristles

Strength

n = 10	$F_{\max}$ [N]	dL of $F_{\max}$ [M]
$\bar{x}$	27.0	104.9
S	1.69	11.7
v] [%]	6.26	11.11



Elasticity

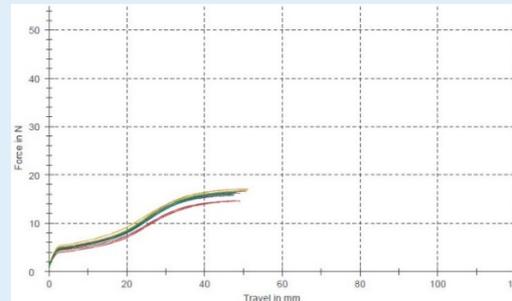
$F_{\max}$  N Strength  
dL at  $F_{\max}$  Elasticity

Conclusion:  
Plastic bristles (Polyester) were 68% stronger and more than twice as elastic as metal detectable bristles.

Metal detectable

Strength

n = 10	$F_{\max}$ [N]	dL of $F_{\max}$ [mm]
$\bar{x}$	16.6	48.3
S	0.826	1.3
v] [%]	5.16	2.74



Elasticity



# Optimising plastic foreign body control

- Metal detectable brush bristles were only available
  - In grey – difficult to visualise in many food types
  - In diameters  $>0.35$  mm - may compromise cleaning efficacy when used with fine powders (inc. some allergens).



# Vikan Ultra Safe Technology – bristle security



- Find out more about UST's unique bristle fixation:
  - <https://www.vikan.com/int/services/vikan-blog/understanding-bristle-fixation-in-food-industry-brushware>
- And how it is helping Nestle reduce their risk of foreign bodies
  - <https://www.vikan.com/int/services/case-stories-and-testimonials/nestle>



# Optimising plastic foreign body control

- Choose metal/X-ray detectable products with good detectability.
- Choose products of a contrasting colour to the food produced – aids visual identification
- Choose durable, well constructed equipment
- Regularly inspect and replace equipment, especially those that are used in contact with food and food contact surfaces.
  - <http://viewer.ipaper.io/vikan/white-papers/cleaning-tool-maintenance/cleaning-tool-maintenance-whitepaper-en-300/>



# Optimising plastic foreign body control

- Optical/visual inspection systems – including your eyes and systems utilising AI technology
- Filters & Sieves – may be fitted along the production line as a means of capturing most foreign bodies in material (particulate, liquid) flows.
- Physical separation equipment - e.g., gravity separators



# Take-home messages from today:

## Metal detectors

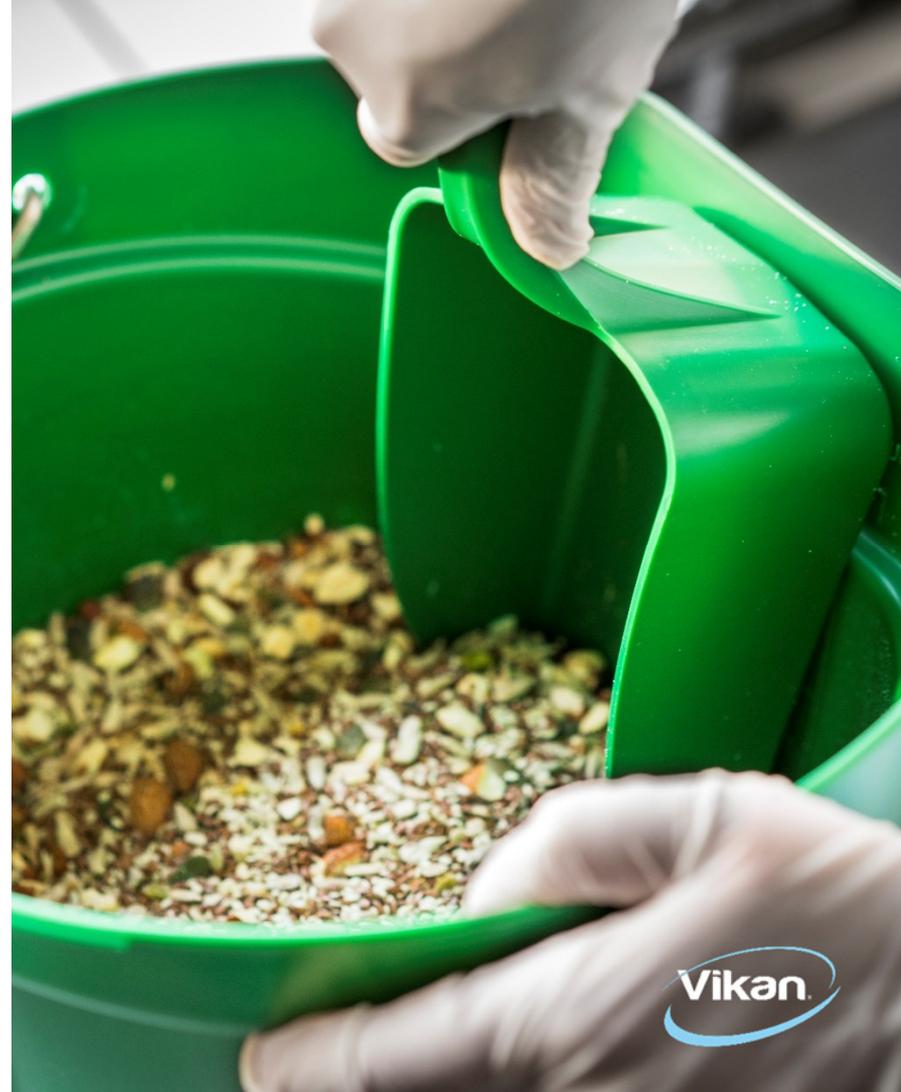
- Metal detection systems are designed to detect metal
- Many factors can affect their performance
- Even when well calibrated, they are not 100% effective (even with regard to detecting metal)
- The use of metal detectors is **NOT**, *per se*, a GFSI food safety audit scheme requirement
- The requirement is to base the decision on risk assessment.



# Take-home messages from today:

## Metal detectable plastics

- The detectability of metal detectable plastics varies enormously
  - Selection of equipment made from appropriately detectable materials is crucial
- Size matters!
  - Metal detectable plastics are mainly plastic, so you need a bigger piece to get a similar detection to that of metal
- Appropriate calibration of the metal detector is essential



# Take-home messages from today:

## Metal detectable bristles

- Metal detectable bristles were not detectable in the presence of food
- Plastic bristles are 68% stronger than metal detectable ones
- Metal detectable bristles are only available in grey - poor visibility in product
- Metal detectable bristles in diameters  $>0.35$  mm may compromise cleaning efficacy when used with fine powders (inc. some allergens)



# Further information and support

- Visit our foreign body control hub
  - <https://www.vikan.com/int/services/metal-detectable-products>
- European Hygienic Engineering Design Groups Foreign Bodies Guideline
  - Publication expected 4<sup>th</sup> Quarter 2023
- <https://www.ehedg.org/guidelines-working-groups/guidelines/guidelines>



Questions?

# Further information and support



**Robert Rogers**

Senior Advisor – Food Safety &  
Regulation

**Mettler Toledo**

Tampa, Florida, United States  
[Robert.Rogers@mt.com](mailto:Robert.Rogers@mt.com)



**Deb Smith**

Global Hygiene Specialist

**Vikan**

United Kingdom  
[dsmith@vikan.com](mailto:dsmith@vikan.com)

# Vikan Food Safety Webinar Series

What's next?



**Topic:**

Food Safety Culture

**Date & Time:**

26<sup>th</sup> October 2023  
3 PM CEST (9 AM EST)

**Presenter:**

Amit M Kheradia, Remco