Hygiene Monitoring in Food Production

Contents of the lecture

Food safety

HACCP

Environmental monitoring

- Contact plates and DipSildes
- NAD and ATP Testing
- Air monitoring

Food Safety

Food safety is a scientific discipline describing handling, preparation, and storage of food in ways that prevent food borne illness.




Food borne illness (also food borne disease) **is any illness resulting from the consumption of contaminated food.**

Food Safety

Annual Burden of Food borne illness in the United States

Total

- 76 million illnesses
- 325,000 hospitalizations
- 5,000 deaths

Known Pathogens

- 14 million illnesses
- 60,000 hospitalizations
- 1,800 deaths

Source http://www.cdc.gov/

Food Safety

Public health burden of food borne disease: US as example

Each year an estimated 76 million cases

- 1 in 4 Americans gets a foodborne illness each year
- 1 in 1000 Americans is hospitalized each year
- At least $56.5 billion annually in medical and associated costs due to foodborne illness

3.5 million cases, 33,000 hospitalizations and 1,600 deaths are caused by 5 pathogens

- Salmonella
- E. coli O157:H7 and other STEC
- Campylobacter
- Listeria monocytogenes
- Toxoplasmosa

Source http://www.cdc.gov/

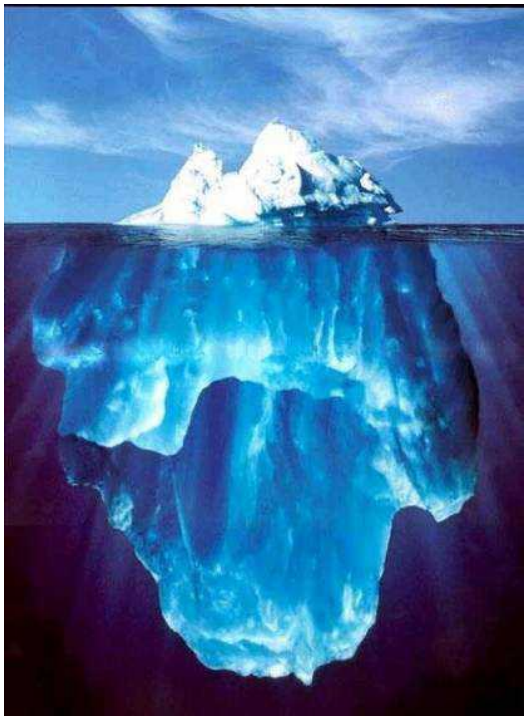
Food Safety

Sources of foodborne pathogens:

Pathogens	Sources
C. Botulinum	Home canned foods
Campylobacter	Poultry, raw milk
Cyclospora	Imported berries
E. Coli O157:H7	Ground beef, produce, water, animal contact
Listeria monocytogenes	Ready to eat meats, pate, soft cheeses
Norovirus	Ill food-handlers, produce, shellfish
Salmonella	Meat, eggs, raw milk, animal contact
Toxoplasmosis	Cat feces, raw meat (pork, lamb venison)
Vibrio	Shellfish
Yersenia	Pork products (chitterlings)

Food Safety

The infections we see are only the tip of the iceberg…..or the eyes of the hippo!



Food Safety

...improve human health through safer food

Our goals:

- Reduce global burden of foodborne disease
- Advocate a human health focus in food production and trade
- Minimise the effect of new foodborne hazards
- Provide a scientific basis for food safety standards
- Raise the importance of food safety as a health issue
- Improve countries' capacities to improve food safety

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HACCP

Environmental monitoring

- **Contact plates and DipSildes**
- **NAD and ATP Testing**
- **Air monitoring**

HACCP

What exactly means HACCP??

- **Have A Cup of Coffee & Pray???**

NO it means…

Hazard

Analysis (of)

Critical

Control

Points

HACCP

How does HACCP work?

HACCP is based on 7 principles!!

1. Assess the hazards
2. Identify critical control points
3. Establish critical limits for each CCP
4. Establish Monitoring procedures for control points
5. Establish corrective action
6. Verify the system is working
7. Develop Effective Record Keeping

HACCP

What is the best time to implement a food safety program?

It was 20 years ago!!

The next best time is

NOW!!!

Contents of the lecture

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Hygiene monitoring

HACCP builds food safety into the manufacturing process and relies on process controls like

Cleaning Monitoring and Air Monitoring.

Hygiene monitoring

The major risks factors which contribute to the most foodborne illnesses are:

- Contaminated equipment
- Poor personal hygiene
- Inadequate cooking
- Improper holding temperature

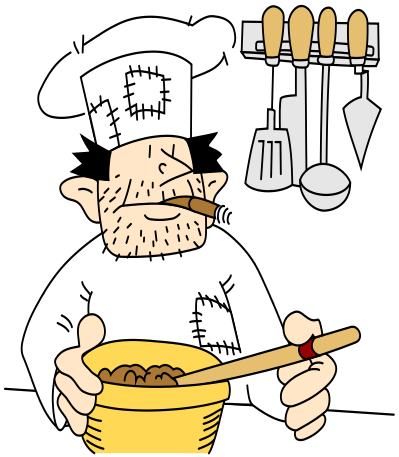
Hygiene monitoring

Cross contamination

Cross-contamination is the transfer of a harmful substance from one food to another food by vehicles such as human hands, contaminated food contact surfaces of equipment, utensils, or directly from a raw food to a ready-to-eat food.

How does it happen?

Contamination by consumers



Food and/or ingredient contamination

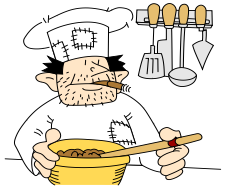
Contact with food workers

Contact with food contact surfaces of equipment, utensils, and wiping cloths

Contamination from ice

Hygiene monitoring

Contamination by Food handler

Inadequate hand washing **Untrimmed fingernails** **Soiled clothing**		Wet hands using hot water Apply soap Lather and wash for 20 seconds Dry with paper towels
Eating, drinking, or using tobacco **Improper use of hair restraints**		Never while preparing or serving food Never around equipment or dishwashing areas ONLY in designated areas Wash hands after smoking
Cuts and abrasions		Clean the wound Cover with clean dry bandage Cover with disposable glove Change gloves at appropriate hand washing intervals

Hygiene monitoring

Protecting food

Stored food 	▪must be protected from cross-contamination ▪use the “first-in-first-out!“ rule ▪Store ready-to-eat foods above raw foods in refrigerators ▪Keep foods covered while in storage ▪cleaning and sanitizing agents) and toxic substances are well-labeled and stored separately from food items. ▪all stored foods should be stored at a minimum of six inches above the floor
T e 	▪Keep potentially hazardous foods out of the temperature danger zone ▪All thermometers that are used to check food temperatures must be calibrated regularly to ensure accuracy •Only thermometers that are accurate and can be calibrated should be used

Hygiene monitoring

- **Cleaning Monitoring**

  - ✓ Contact Slides / Plates
  - ✓ HY-Lite® ATP Test
  - ✓ HY-Rise® NAD Test

- **Air Monitoring**

  - ✓ MAS-100 Eco®
  - ✓ MAS-100 CG Ex

Hygiene monitoring

Settle plates

for Isolators and Clean Rooms **for Active and Passive Air Sampling**

All plates are stored at **room temperature** (+15°C to +25°C), hence cooling capacities won't be blocked. **Storage at site of application is possible.**

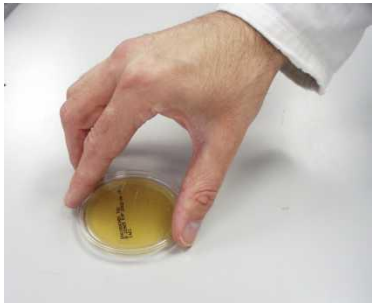
Product name, expiry date, lot number and serial production number are imprinted on each Settle plate for safe and easy product identification and shelf life monitoring.

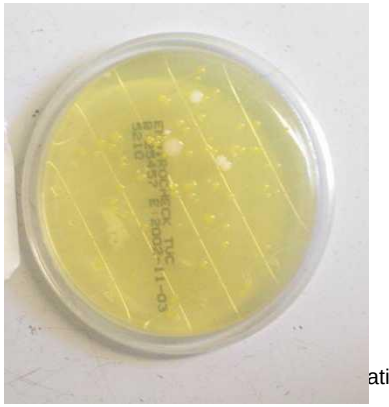
Hygiene monitoring

Settle plates for Isolators and Clean Rooms

- ✓ **Storage at +15°C to +25°C**
- ✓ **90 mm diameter plates**
- ✓ **Gamma irradiated**
- ✓ **Triple wrapped – (2 sets of 10 plates each)**
- ✓ **H_2O_2 –impermeable inner bag**
- ✓ **4 neutralizers**
- ✓ **Reduced formation of condensation water**
- ✓ **Long incubation time possible**
- ✓ **Filling Volume 25 ml**
- ✓ **Long shelf life - up to 9 month**

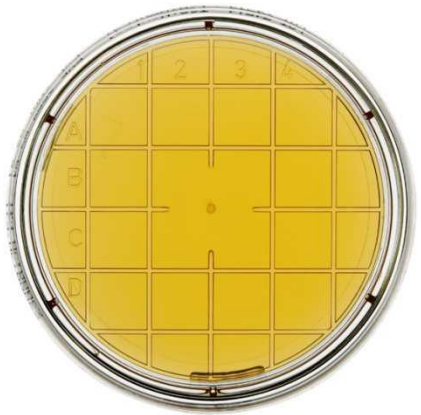
Hygiene monitoring





Contact Plates

For the detection and enumeration of microorganisms on enviromental surfaces, manufacturing plants, and equipment.



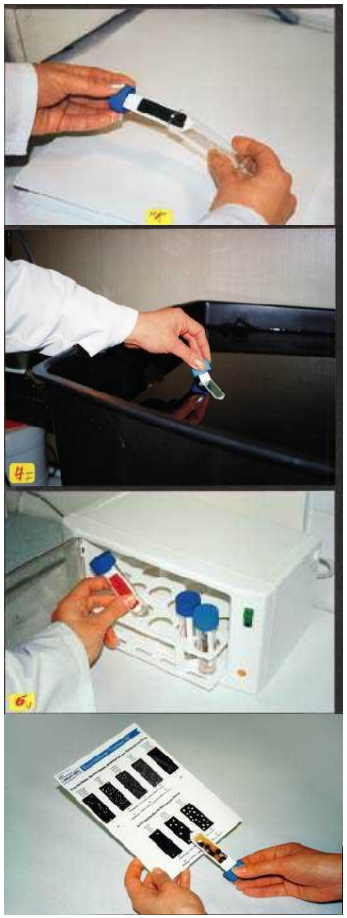
Hygiene monitoring

Contact plates for Hygiene Monitoring of surfaces

for Food and Beverage Industry – NON sterile areas

- ✓ 55 mm diameter plates
- ✓ Storage at +15°C to +25°C
- ✓ Reduced formation of condensation water
- ✓ Long shelf life - up to 9 month
- ✓ Single bagged - (2 sets of 10 plates each)

Hygiene monitoring



Envirocheck® Contact slides / Dip slides

for Hygiene Monitoring of Surfaces and in Liquids

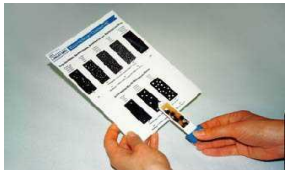
For the microbiological hygiene control of surfaces and liquids in production lines and equipment.

Both sides of a flexible paddle are coated with culture medium.

Allows sampling even in areas difficult to reach

Hygiene monitoring



Product	Ord. No.	Shelf life in month	Slides per pack
Contact DC For disinfectant control	1.02147.0001 side A: Tryptic soy agar side B: Tryptic soy agar with neutralizer	8	10
Contact TVC For Total Colony Counts	1.02149.0001 side A: Nutrient agar with TTC side B: Nutrient agar	8	10
Contact YM(R) For the detection of Yeasts and Moulds	1.02139.0001 side A: Tryptic soy agar with TTC side B: Rose Bengal Chloramphenicol agar (R)	6	10
Contact E For the detection of Enterobacteriaceae	1.02137.0001 side A: Plate count agar side B: VRBD agar	6	10
Contact C For the detection of Total coliforms/E.coli	1.02136.0001 side A: Plate count agar side B: Chromocult® Coliform agar	8	10

Hygiene monitoring

Limitations of microbiological hygiene control with Contact Plates/Slides

- Does not detect food residues
- Does not detect (recover) all micro-organisms
- Detects micro-organisms **after 1- 7 days**

Hygiene monitoring

Rapid Testing

HY-LiTE®

HY-RiSE®

To be of practical value to the manufacturer, a sanitation monitoring system must give results fast enough to allow necessary corrective action before restart of production.

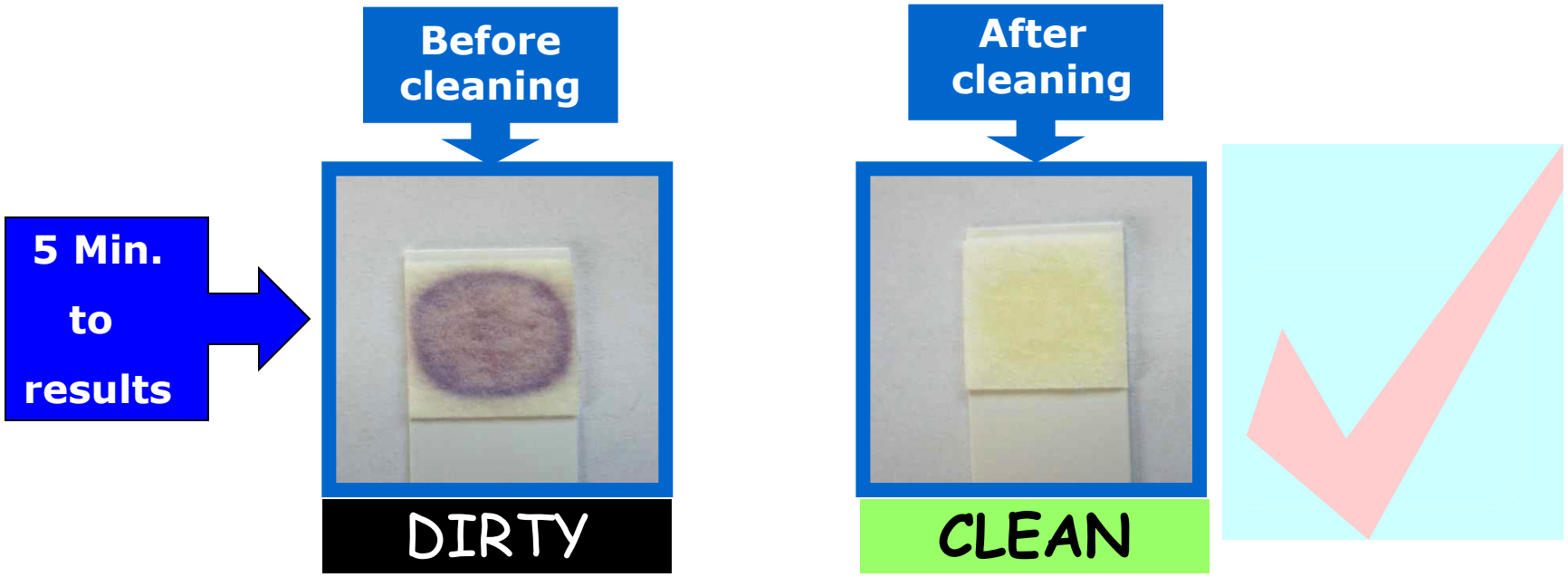
Hygiene monitoring

HY-RiSE® NAD (nicotinamide adenine dinucleotide) colour test strip

- Visual test (no reader)
- Qualitative test
- Simple to perform
- Results in 5 minutes
- Reagents stable at room temperature
- More sensitive to micro-organisms than similar colorimetric tests for sugar or protein
- Suitable for confirmation of cleaning operations in Hotels / Restaurants / Catering / Retail

Hygiene monitoring

Is it clean or dirty? A *simple* answer…



***Example pictured*: Glass plate from a domestic microwave oven (clean to the eye prior to testing).**

Hygiene monitoring

HY-LiTE® 2 System

For the rapid detection of total ATP, this is a completely new method to measure cleanliness.

HY-LiTE® 2 Luminometer with built-in printer

TREND 2 Software

HY-LiTE® Pens

Hygiene monitoring

How can ATP-Bioluminescence be used for measuring cleanliness?

- Levels of ATP can be used to indicate the cleanliness of surfaces that could come into contact with food.
- Relative Light Units are directly proportional to ATP
- Measuring the light released by this reaction, allows an accurate determination of the quantity of DIRT+ MICROORGANISMS =ATP present.
- The HY-LiTE® 2 system is a luminometer, counting photons out of the bioluminescence light reaction.

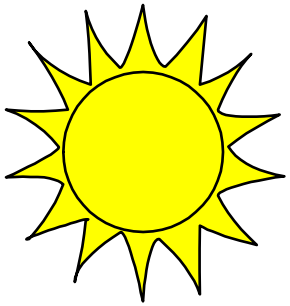
Hygiene monitoring

Experimental results

Bacterial growth can only occur on Food residues

Therefore **Food residues must be completely** removed by cleaning

→ Microbiology can not detect Food residues



Hygiene monitoring

Experimental results

Sterile = clean ??

Even on STERILE surfaces
HY-LiTE detects up to 1000 RLU

„Sterile“ therefore does NOT mean clean

„Not clean“ means RISK for contamination

Hygiene monitoring

Experimental results

Time factor

HY-LiTE can detect ATP from Food residues and other contaminations – **Rapidly**

Microbiology can detect living Microorganisms which are growing on the used medium - **But only after 1-2 days**

Hygiene monitoring

PASS / FAIL Limit setting

Values are only a rough guideline

Production environment	Pass	Fail
Raw Milk	100	300
Raw Meat / Fish / Egg	300	1000
Raw Vegetable / Fruit	500	1500
Processed Milk / Milk products	70	200
Processed Meat / Fish / Egg	70	200
Processed Vegetable / Fruit	200	600
Mass Catering / Flight Catering Facilities	500	1500
Beverages	50	100

Hygiene monitoring

The HY-LiTE® pen

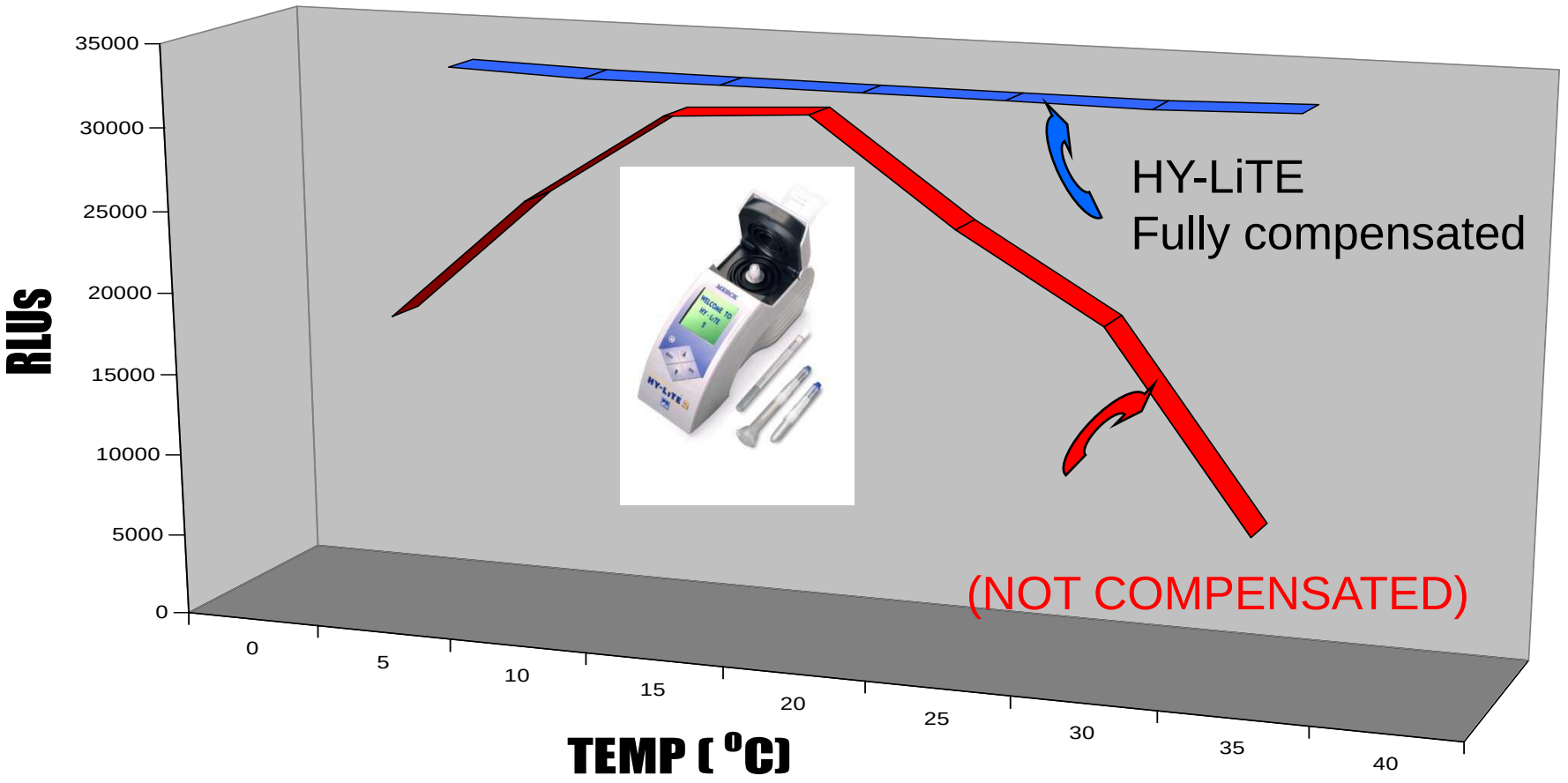
2 formats

- Surface test pen with rinse tube and swab
- Liquid test pen for CIP rinse water samples

Very resistant to chemical interference

- Dilution of sample in rinse tube
- High buffer to sample volume in pen
- Efficient neutraliser against QUATs and similar detergents
- High buffer capacity against extreme pH

TEMPERATURE COMPENSATION



Hygiene monitoring

Hygiene monitoring

Merck´s Air Sample

MAS-100 NT®

MAS-100 EX NT®

MAS-100 Eco®

DA-100 NT®

MAS-100 CG Ex®

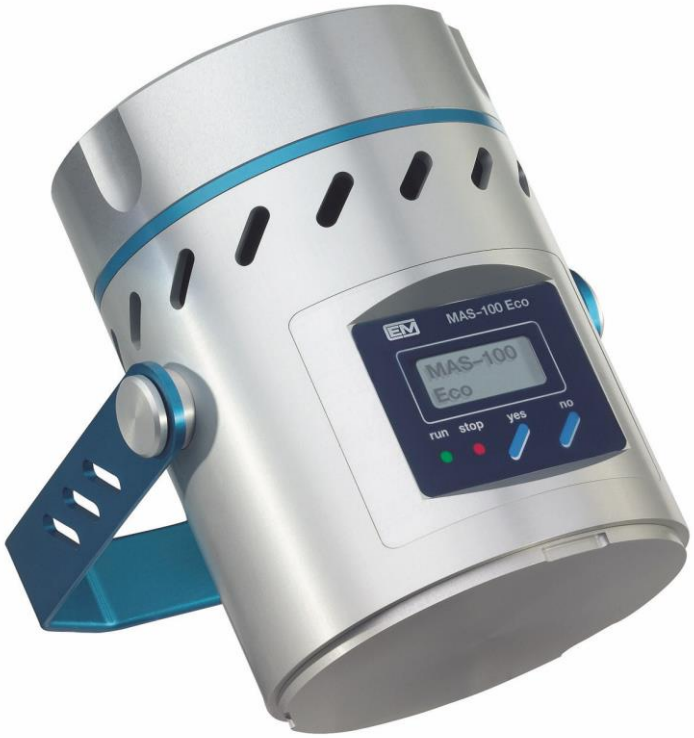
Hygiene monitoring

MAS-100® Eco

Microbial air sampler

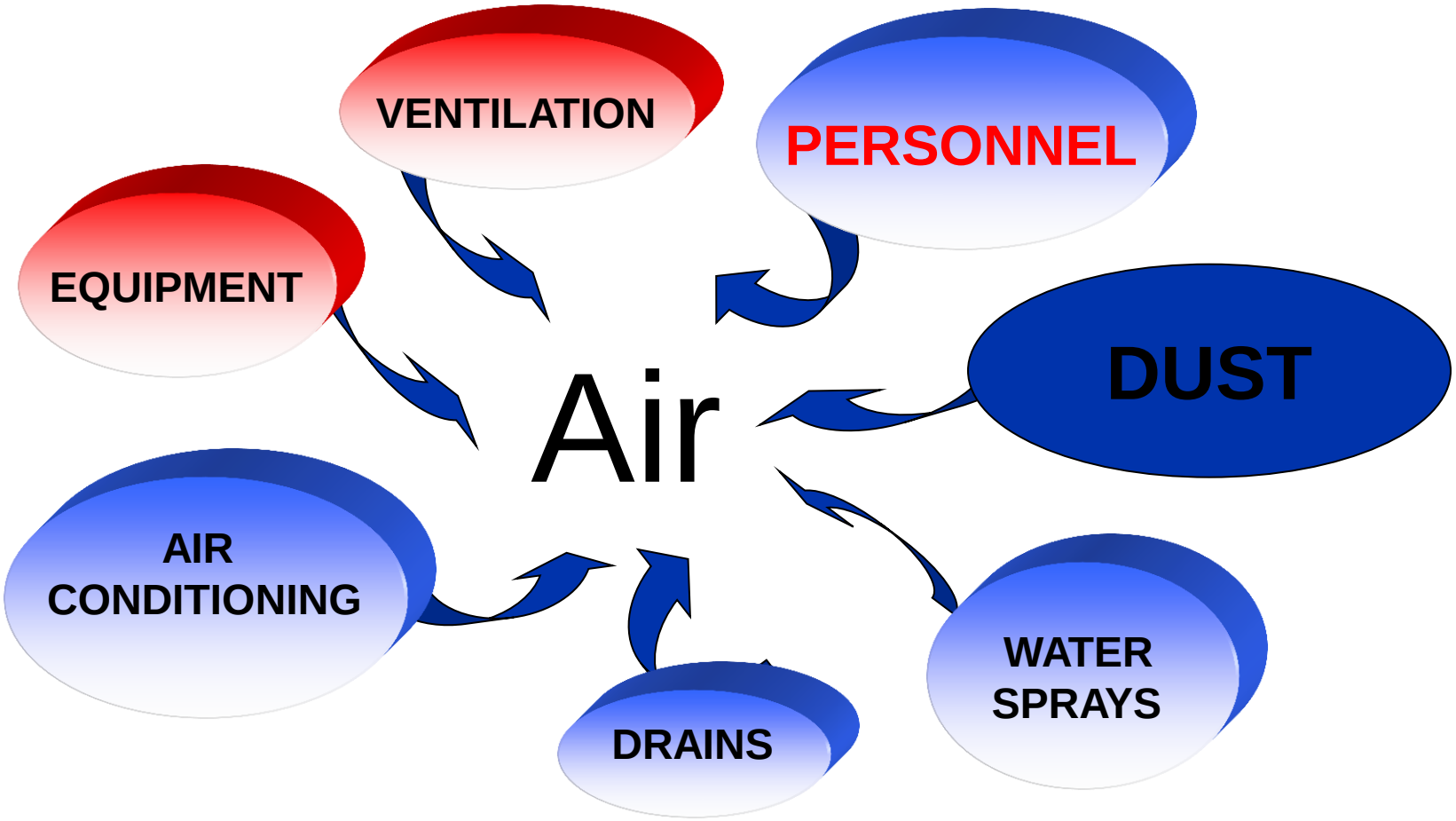
to count microbes in a

defined volume of air



Hygiene monitoring

Sources of airborne contamination



Hygiene monitoring

Microbiological Air Monitoring

Which airborne bacteria are isolated usually ?

Airborne bacteria	Possible source
Staphyloccoci	from skin
Micrococci	from skin
Pseudomonas	from water
Bacilli	from soil, environment
Coryneform bacteria	from skin

Hygiene monitoring

Source Personnel

People are the largest contributor of airborne particles in a Clean room.

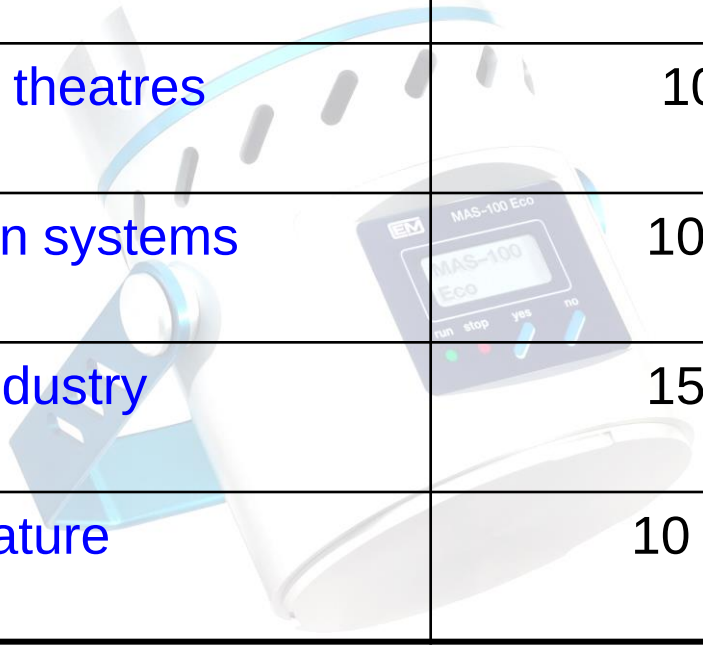
- **1 Person** shed 1 billion skin flakes per day.

How many 0.3 micron particles does a person shed in 1 Minute?	
Activity	**Particles per Minute**
Person sitting or standing	100,000
Moving arm	500,000
Walking slowly	5,000,000
Walking at an average pace	7,500,000
Walking quickly	10,000,000

Hygiene monitoring

Micro organism titers in different environments

Clean rooms and Isolators	0 - 200 cfu / m^3
Operation theatres	10 - 200 cfu / m^3
Air-condition systems	10 - 1000 cfu / m^3
Food industry	15 - 5000 cfu / m^3
In free nature	10 - 10000 cfu / m^3



Hygiene monitoring

Why air monitoring in the food and drink industry ?

requirement for higher quality, longer shelf-life

customers increasingly health conscious

low or no preservatives used, to protect the product

clean rooms for products free of contaminants

Hygiene monitoring

Levels of airborne organisms in food industry

Some opinion leaders recommend the adaption of a similar classification system for the food industry, as used in pharmaceutical areas

classes according to EUR GMP **further classes defined individually**

class	**A**	**B**	**C**	**D**	**E**	**F**
cfu /m^3	**< 1**	**5**	**100**	**200**	**500**	**2000**

Hygiene monitoring

MAS-100 Eco®

- ✓ **well-known MAS-100 principle**
- ✓ **smart design**
- ✓ **volumes between 1 and 1000 liters**
- ✓ **for standard Petri dishes**
- ✓ **price only 60 % of standard MAS-100**

difference: without airflow compensation, shoulder bag and tripod screw

Hygiene monitoring

Settle Plates

The perfect solution for Air monitoring

Contact Plates

Hygiene monitoring

MAS 100® Air-Sampler's result

After incubation the colonies are counted and expressed as **c**olony **f**orming **u**nits (**cfu**) per m^3

Hygiene monitoring

Hygiene monitoring

Why Test Compressed Gases?

Gas that contact product can effect product quality.

These gases should be qualified and monitored with appropriate actions taken if limits are exceeded.

Hygiene monitoring

MAS-100 CG Ex

(Merck Cat.-No. 1.09327.0001)

Applications:

Pharmaceutical Industry:

Compressed gases like air, nitrogen, carbon dioxide and argon and new **oxygen**. Used for ampoule filling or for filling of containers under atmosphere of inert gas to avoid oxidation of final product.

Food Industry:

Inert gas: nitrogen and argon; used to protect food from oxidation and to prohibit growth of aerobic micro-organisms.

Hygiene monitoring

Common Compressed Gases used:

Air

Nitrogen

Carbon Dioxide

Argon

Oxygen

MAS-100 CG Ex

(Merck Cat.-No. 1.09327.0001)

Hygiene monitoring

Increased Focus on Practices for Testing Compressed Gases

FDA guidance document on Aseptic processing mentions the microbial filtration of compressed gas supplies

FDA focusing on compressed gas sampling during audits.

Current manual sampling methods both inaccurate and problematic.

Many companies looking at new technologies for compressed microbiological testing

MAS-100 CG Ex

(Merck Cat.-No. 1.09327.0001)

Hygiene monitoring

Guidelines:

According to EN ISO 14698-1

> “Compressed gases must be analyzed for the presence of micro-organisms.”

In accordance with the guidelines for pressure vessels 97/23/EG

SNCH 02 ATEX 3418 guidelines for explosion risk areas

CE conformance EN 50021:1999

Hygiene monitoring

ISO 8573-7: "Compressed air – Part 7: Test method for viable microbiological contaminant content"

Specifies a test method for distinguishing viable, colony-forming, microbiological organisms (yeast, bacteria and endotoxins) from other solid particles in compressed air.

- ✓ References:
- ✓ ISO 8573-1, Compressed air – Part 1: Contaminants and purity classes
- ✓ ISO 8573-4, Compressed air – Part 4: Test methods for solid particle content

Hygiene monitoring

Hygiene monitoring

MAS-100 CG Ex

(Merck Cat.-No. 1.09327.0001)

Basic principle:

MAS 100 CG Ex®

The MAS-100 CG Ex is based on the principle of the Andersen air sampler.

Use of standard 90mm Petri dishes

Samples are taken under pressure

open sampling head with Petri dish

Hygiene monitoring

MAS-100 CG Ex

❖**Display:** MAS-100 CG ex

Independent manometer

Pressure LED flashing if pressure is > 1bar

Run/stop LED

Easy programming with yes/no button

Hygiene monitoring

❖Major advantage MAS-100 CG Ex

If a gas is compressed for example to 5 bars it reduces its volume 5 times. If the gas expands from 5 bar to ambient pressure it increases its volume 5 times in the very moment or instantly when it comes out of the gas pipe!

Lets compare this process with a diver! What happens if a diver comes up from 50 Meters below sea level within 1 sec. He will die because of the rapid change in pressure!

Let's go back to the MAS-100 CG.

The possible microorganisms are collected in our system at the pressure where they live. After the collection cycle the MAS-100 CG stops and then a decompression cycle has to be activated **(like divers do which come slowly up to the surface)** in order not to damage or kill the microorganisms of to rapid pressure changes.

Hygiene monitoring

A complete range of precise air samplers

• MAS-100® NT	The bestseller in the pharma-industry
• MAS-100 Ex® NT	The special version for ex-areas
• MAS-100 Eco®	The air sampler for the F&B industry
• MAS-100 ISO®	The built-in version for Isolators
• DA-100® NT	The digital calibration unit
• MAS-100 CG®	The air sampler for compressed gasses

Hygiene Monitoring in Food and Beverage Industry

Thank you for your attention