"Cleaning in place" process analysis

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Objekttyp: **Article**

Zeitschrift: **Mitteilungen aus Lebensmitteluntersuchungen und Hygiene = Travaux de chimie alimentaire et d'hygiène**

Band (Jahr): **99 (2010)**

Heft 1

PDF erstellt am: **16.07.2024**

Persistenter Link: https://doi.org/10.5169/seals-982060

"Cleaning in Place" Process Analysis*

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Summary

The presentation on CIP (Cleaning in Place) Process Analysis has 4 parts.

The first part describes the cleaning process from the view of the dairy industry. The target of the CIP process is to remove food residues and dirt. For this, the 6 "Ts" are essential: Turbulence, Time, Temperature, Titration, Technology and Training.

In the second part the fishbone diagram for problem solving is used with the 4 "Ms": Man, Method, Material and Machine. The more automated a line is, the more important the human factor becomes. For this, training is the key word. Two video clips are shown, since for the understanding images are worth more than 1000 words. The first video clip shows 3 different velocities in a glass tube with changing diameter. The cleaning effect is only sufficient with a velocity of at least 1.5m/s. The second video clip shows two different dead ends. Cleaning with CIP can be only done efficiently in dead ends with a length of less than 1.5 times the diameter.

In the third part, a selection of analytical laboratory methods, which are often proposed, is looked at more critically. The methods are COD (Chemical Oxygen Demand), TPC (Total Plate Count) and Bioluminescence ATP.

The fourth part shows new technology in turbidity measurement, which is very interesting because of the simplicity, rapidity and low costs. Finally, different aspects of sampling will be mentioned.

* Lecture presented at the conference „Hygienic Design" on September 11-12, 2008 in Zurich

CIP Process Analysis

Hygienic Design in der Lebensmittelverarbeitung

SGLUC, SGLH, SGLWT, SVIAL Fachtagung

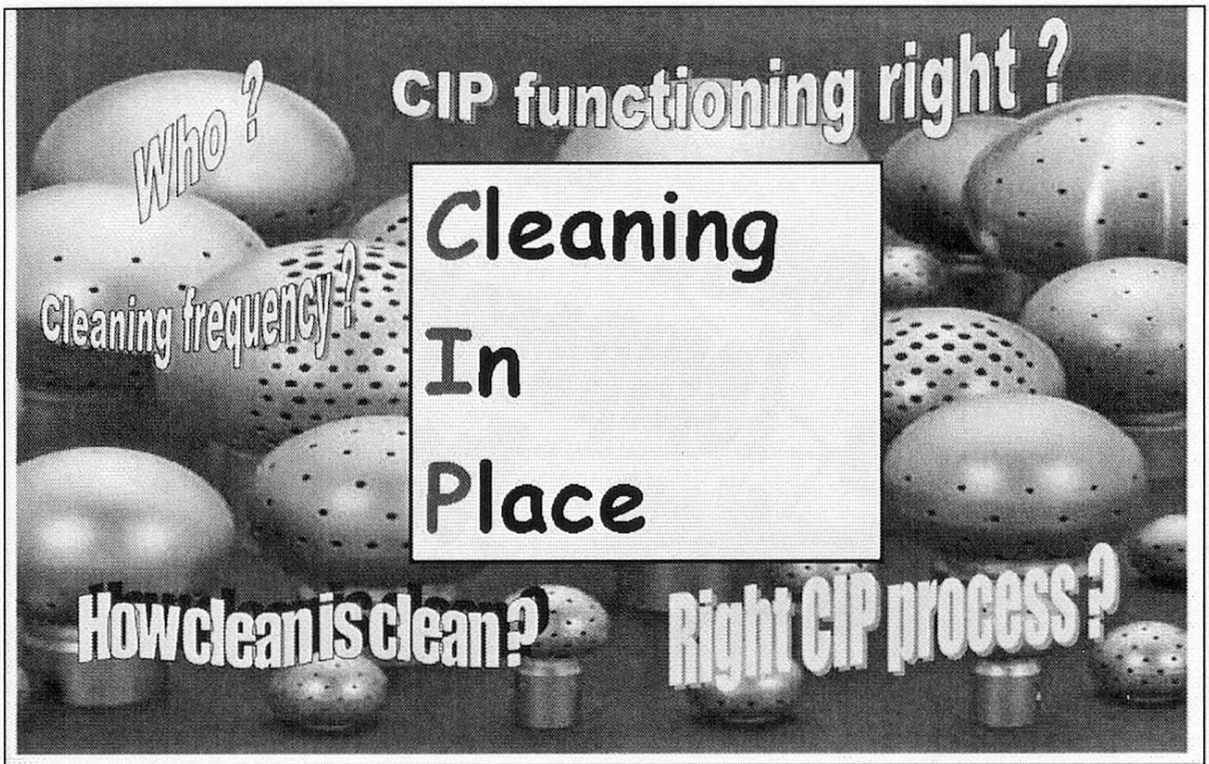
11./12. Sept 2008 ETH Hönggerberg, Zürich

Dr. John C. Brunner
Nestlé Central Operation Unit Quality Management

Nestlé
Good Food, Good Life

Content

- CIP process
- The human factor
- Analytics overview
- Turbidity



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CIP Process

- The purpose of cleaning is to remove food residues and dirt .
(Where as the purpose of disinfection is to reduce the numbers of living microorganisms)
- CIP is part of the production process
- Example CIP cycles dairy industry:
  - Rinsing
  - Caustic
  - Rinsing
  - Acid
  - Rinsing

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CIP, the 6 T's

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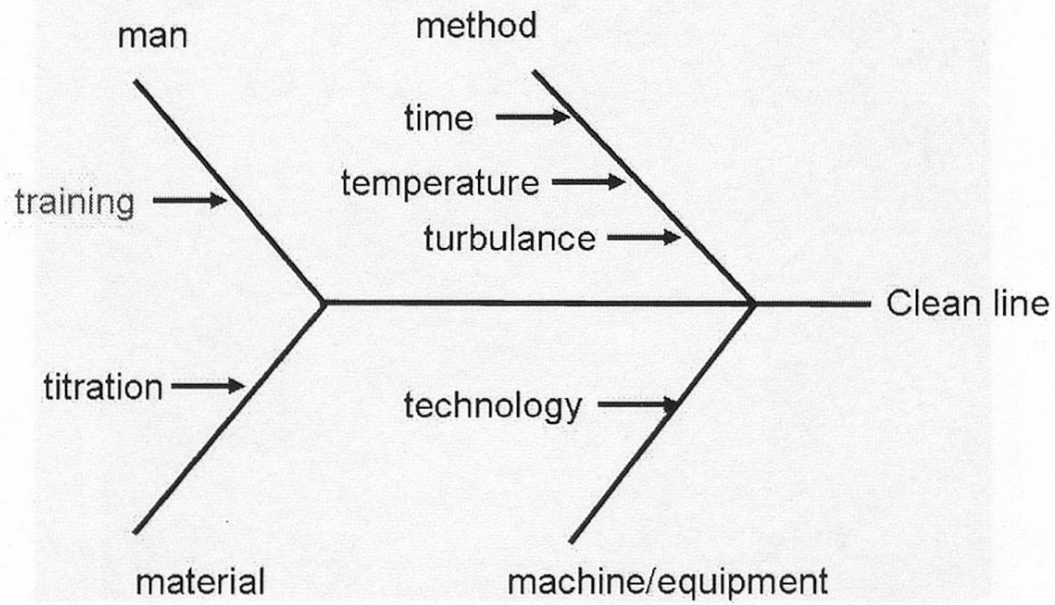
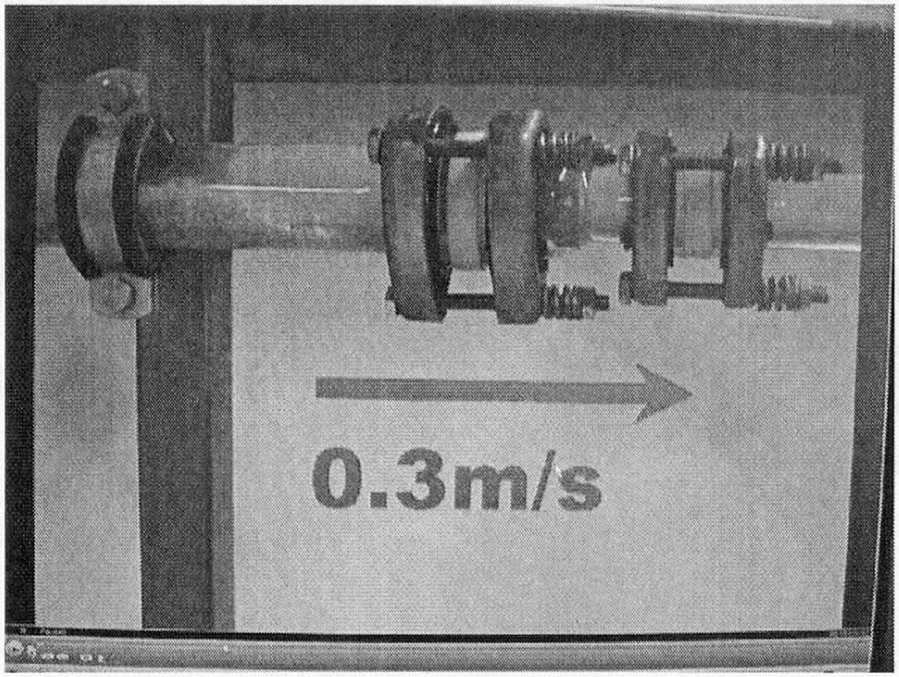
Fish bone diagram for problem solving



Video Clip 1

- CIP module 2:

Turbulance in changing diameters



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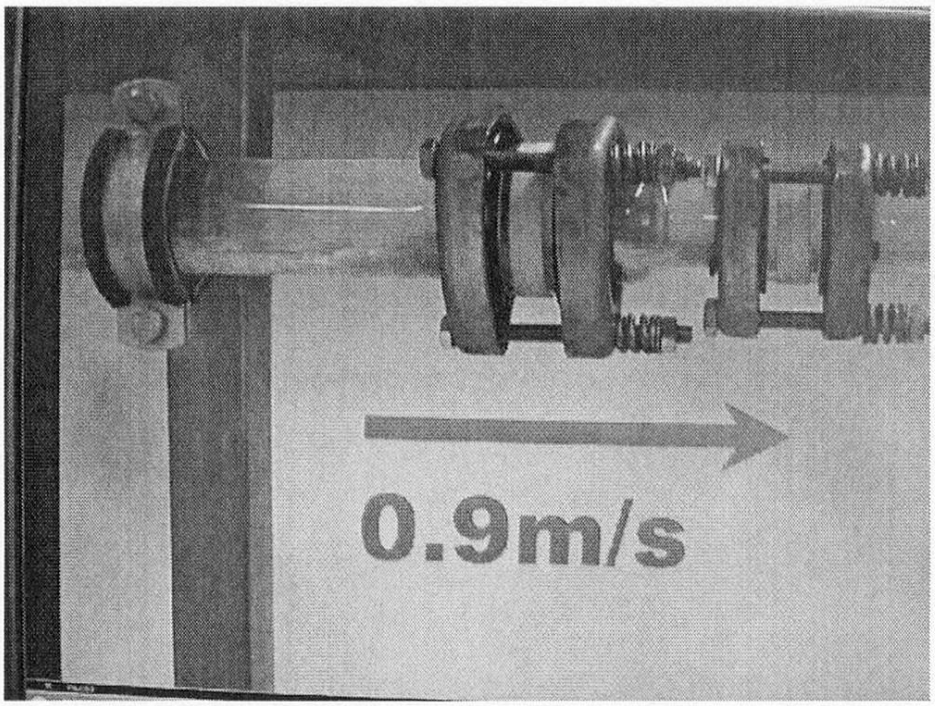

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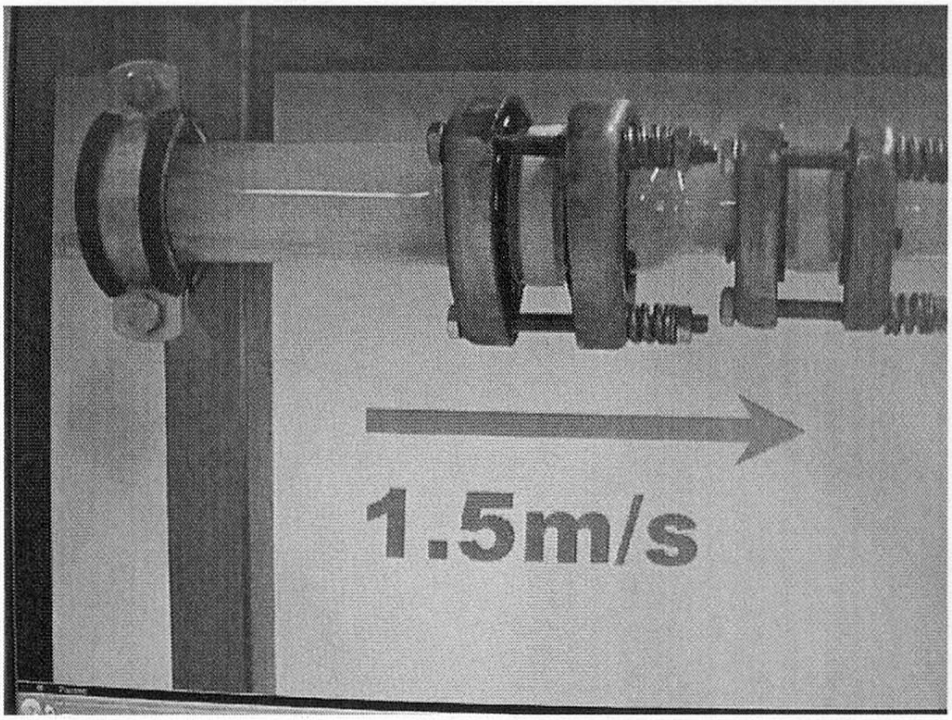
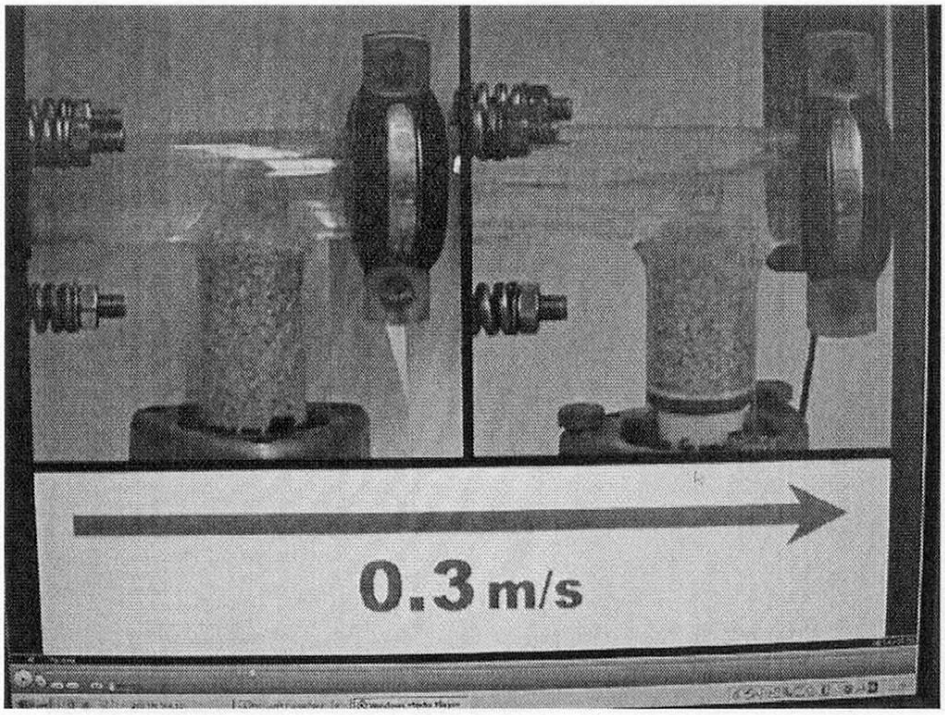


Video Clip 2

- CIP module 5

Vertical Downward Dead End



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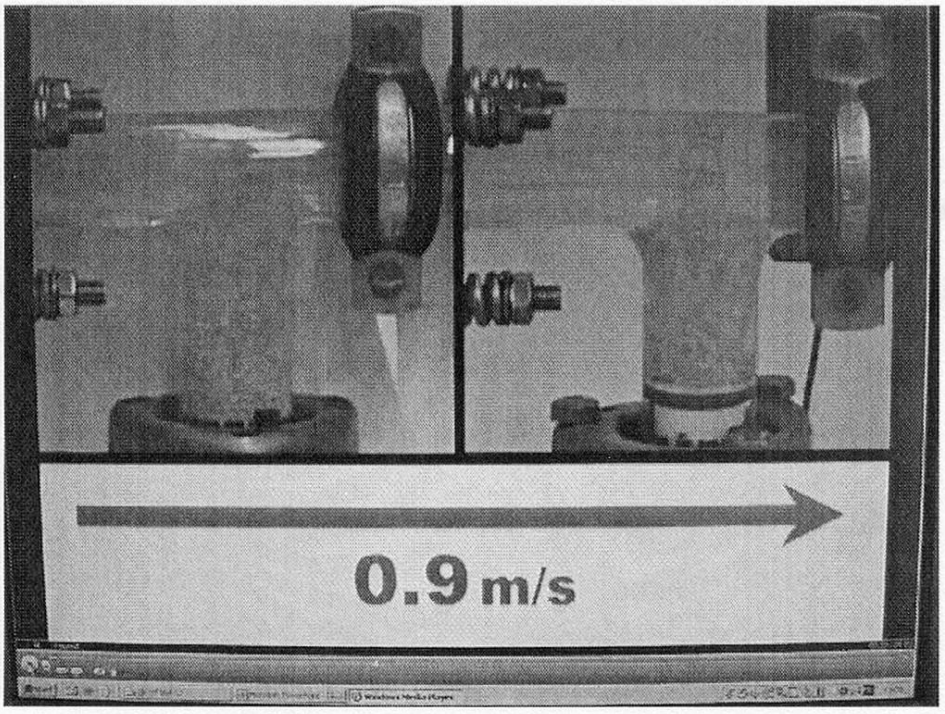

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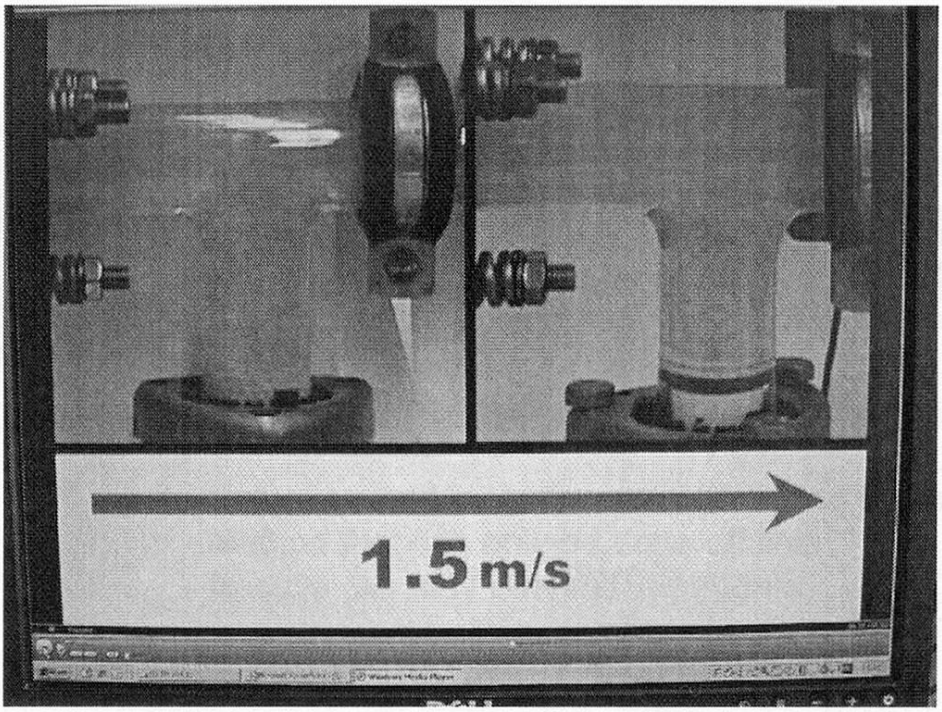

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Visual

- Concentrate on worst spots
- Looking for: no residues, no water, no "rainbow colours"
- Can be enhanced with UV lamps

+ simple

- subjective

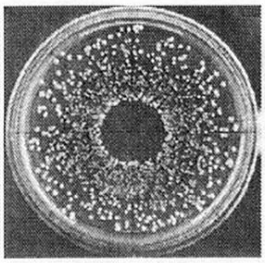
Chemical Oxygen Demand (COD)

• COD (Chemical Oxygen Demand) is the amount of oxygen needed to oxidise reactive chemicals in water, typically determined by a standardised test procedure.

+ It is useful in determining the amount of organic residues in rinse water.
+ Good indication of how successful the rinsing has been

- Method that can only be done off line.
- Results are not instant – test takes 2 hours

Total Plate Count (TPC)

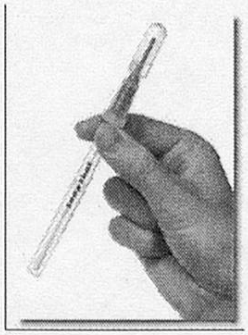


• Diluted samples are grown in a culture medium with incubation. The number of bacterial colonies that grow are then counted.

+ Useful in determining the amount of pathogens and spoilages microbes.
+ Provide relatively low limits of detection (1cfu/mL)-

- Detection limit is too low for CIP rinsing water.
- Method that can only be done off line.
- Results can only been seen in 48hrs.

Bioluminescence ATP



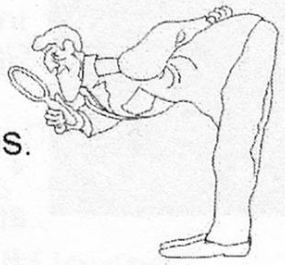
• ATP (Adenosine Triphosphate) is the energy molecule in biological systems. A light is released when the molecule reacts with an enzyme. This light is measured in the form of Relative Light Units (RLU).

+ Rapid test for heavy contaminated/ high organic activity areas.
+ Detects micro-organisms and product residues.
+ Easy to use.

-Detection limit is too low for CIP rinsing water.
- Only indicates cleanliness for the defined area swabbed and not for the entire line or equipment.
- Inaccurate on areas with low contamination/organic activity.
- Expensive

Other Methods Dairy Industry

- Temperature
- Velocity
- Analysis of organic and mineral residues.
- pH
- Titration
- Conductivity
- Turbidity



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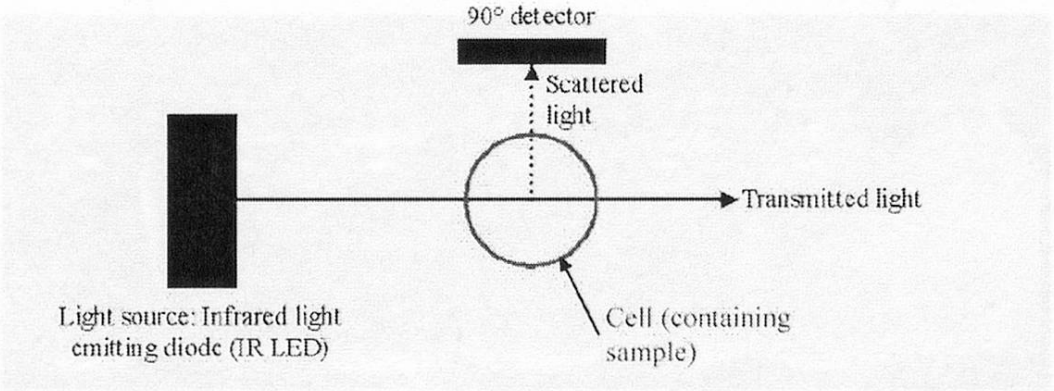
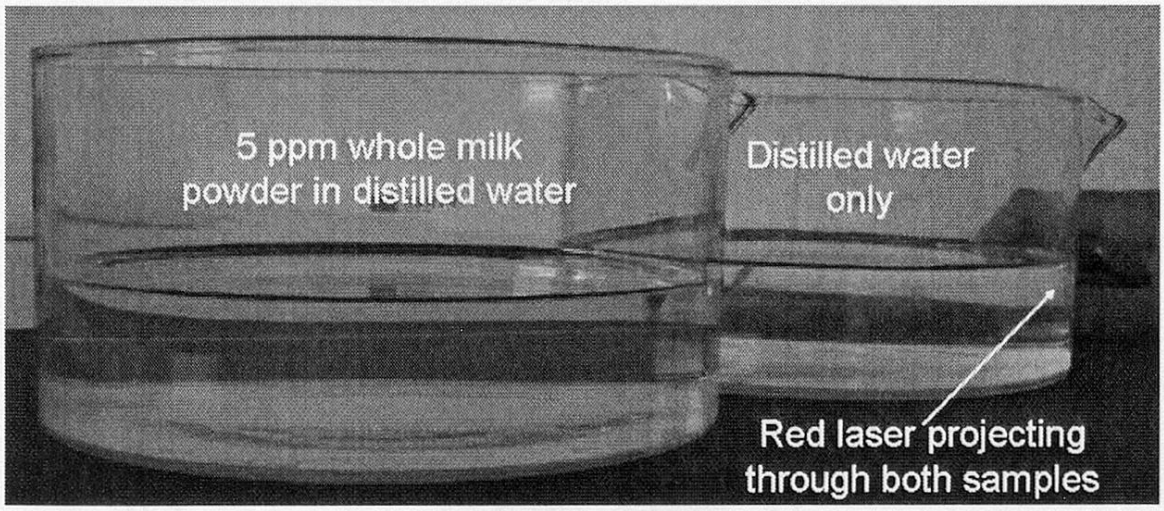
Turbidity Technique: Measurement Principle



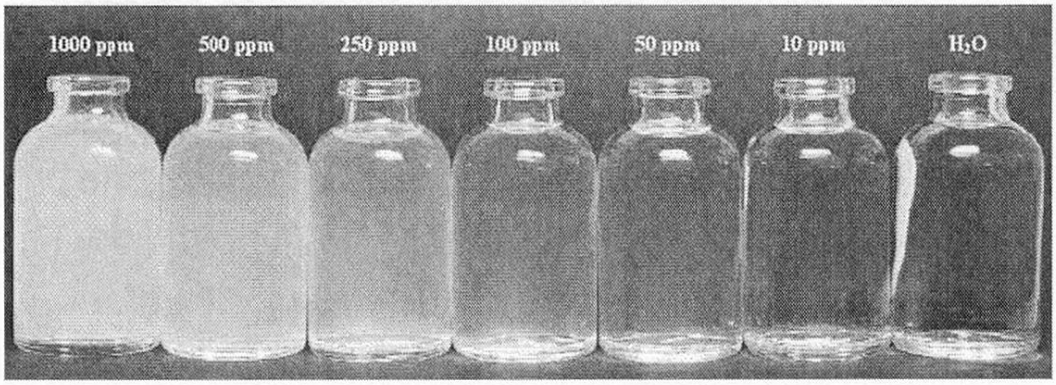
Turbidity Technique: What the Eye Can't See



- At low concentration the human eye is unable to differentiate
- But, the samples are different – shown by light scattering

Laboratory Results

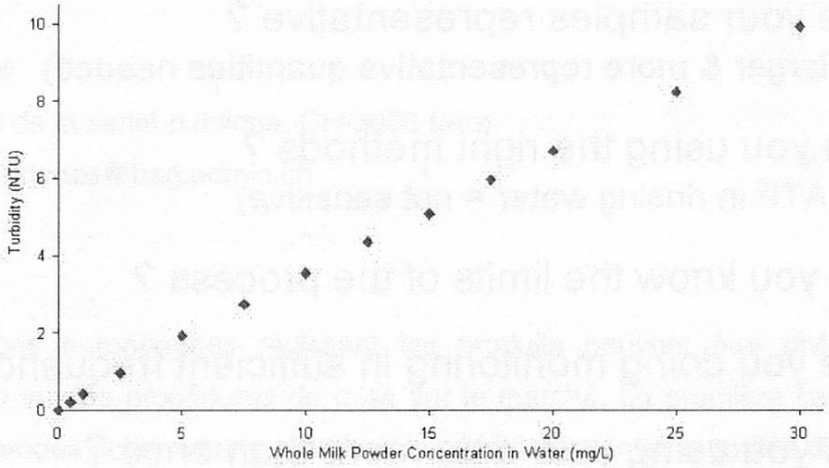
- At low concentration of whole milk powder samples in water, e.g. < 50 mg/L (50 ppm), the human eye is incapable of distinguishing between samples (hence the need for instrumentation)



Equipment: WTW Turb 430 IR Portable Turbidimeter

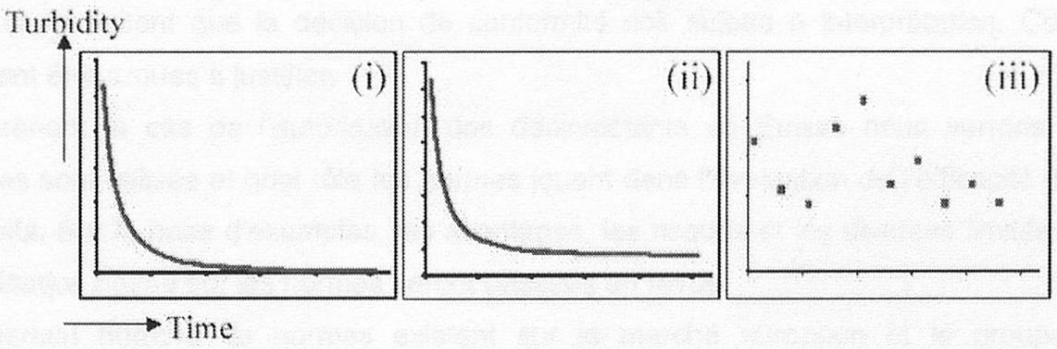
Laboratory Results

- Instrument performance confirmed in laboratory tests
- Figure shows plot of turbidity against whole milk powder concentration



Typical Graphs after CIP

- Three characteristic results were seen:
  - (i) Plateauing effect, before the end turbidity values very close to zero
  - (ii) Plateauing effect, at the end turbidity values greater than those of incoming rinsing water (problems with insoluble salts and minerals)
  - (iii) More random data distribution (problems caused principally by insoluble proteins)



6 questions to take home

- Is your process stable ?
(e.g. difference if cleaning solution recirculated)

- Are your samples representative ?
(e.g. larger & more representative quantities needed)

- Are you using the right methods ?
(e.g. ATP in rinsing water = not sensitive)

- Do you know the limits of the process ?

- Are you doing monitoring in sufficient frequency ?

- Are you using your data more than once ?