

Abstracts

PHARMACY

Lean Engineering for Pharmaceutical Plants - A praxis oriented approach for a lean engineering and realization process

Rüdiger Mechsner, M+W Process Industries

To plan and to operate a pharmaceutical venture is an investment and therefore under stringent economic, technical and regulatory pressure. Same as for manufacturing itself, also for engineering, time, money and resources have to be optimized as far as possible. Applying "lean" means to establish a holistic mindset that helps to systematically identify and eliminating wastes. This presentation considers the principles of how to apply this mindset on engineering and realisation of pharmaceutical installations. The most common traps that usually create wastes are shown. An analysis of the lifecycle of engineering demonstrates the advantages of a rolling planning that automatically realizes necessary corrections of work in progress; this in contrary to a so called ballistic behaviour that requires the maximum accuracy in the beginning of planning tasks and its progressing work is not being changed until finished.

The maxim of putting the engineering itself under the lean concept will naturally support the result of the planning: A lean plant concept for lean manufacturing.

Start-up of new, modern facility (case)

Maija Hietava-Lorenzi, Majjatek

Basic requirements of a new pharmaceutical facility

Every pharmaceutical facility or plant is unique. However, the basic level of the safety of the products produced in that facility should be a common goal to all pharmaceutical facilities. The facility should be designed to build quality into the products. Therefore, first, the quality should be built into the facility and the system. What does it mean to "build quality into a facility"? For a new facility, is it sufficient enough only to validate the manufacturing processes after the construction?

To be successful in getting what is expected and at the same time complying with all the regulatory requirements, the quality building should start as early as possible. It should in fact already start at the designing stage of the new facility and all of it should be in place at the moment of the manufacturing of the first batch for the market or clinical trial. It is certain that the goal to build quality will also help to minimize those countless chances of things going wrong and to foresee up front even those smallest details, which could mysteriously delay or stall a start-up and endanger an on-time and on-cost launch of a facility.

What is quality and how to build quality into a facility during the design, construction, commissioning, qualification as well as the validation stages? What is included in this demanding process? Small companies do not normally have in-house capacity and knowledge for sufficient understanding of each of the details involved, as well as planning around the predicted problems. How is this small organization, which is staffed for ongoing operations but not for the step change represented by a new facility, going to be able to handle the demanding and complex approach to build quality? Furthermore, how to keep the balance between the increasing authority requirements and the amount and level of documentation.

The start-up of Ark Therapeutics Oy new, modern facility

This presentation discusses the start-up of a modern multipurpose facility GMP3, designed and equipped by Ark Therapeutics Oy, Kuopio Finland (ATO) for the manufacturing of injectable recombinant gene therapy vectors used in human clinical trials and for commercial sale. It defines the tools which were used when building quality into the new facility and systems. The in-house capacity of ATO was reinforced by outside professionals. An experienced consulting company in facility constructions and start-up was contracted for the task.

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In ATO the facility was built for the well known processes, which made the design work interesting as well as challenging. The GMP3 facility project was divided into two main stages: the first consisted of the design stage until the performance qualification. The second stage consisted of the performance qualifications, process validations and establishing most of the procedures related to the new facility activities. The first stage was "mastered" by the consulting company. The second stage was planned and led by the ATO personnel, because of its thorough knowledge of the products, manufacturing processes and their particularities.

For building quality into a facility all the stages of the project must be well defined and sufficiently controlled and documented in order to show that all the requirements and specifications set up for the facility are met. In order to define this complex project of construction and start-up of a facility and its very sophisticated processes various documents were established to describe the project in its minutest details. The master documents such as The Quality Activity Plan, The Overall User Requirement Specifications, The Commissioning and Qualification Plan, The Validation Master Plan and The Project Execution Plans for the first and second stages of the project were established. They explain how the work was to be planned and executed, what the requirements for the sub-contractors and documentation were, how the responsibilities were divided between ATO and the consulting company, the organization of the project, the qualification and training requirements of the personnel etc. One of the important details in relation to the documentation was the qualification of personnel for the project. The responsible persons of the project had to insure that each person participating in the project was qualified for the assignment at hand, and therefore each one's qualification was checked and documented.

Risk analysis was the key tool for setting the limits for commissioning, qualification and the level of documentation. It was used at the very beginning of the project to categorize the critical and less critical issues of the project. As the project proceeded the importance of the tests became more significant as well, and subsequently the number and details of the documentation also increased. For instance the number of test steps and the pertaining documentation were increased for the qualification relative to commissioning tests.

Milestones of the facility project

The realized milestones of the facility project at Ark Therapeutics Oy:

- 2007: contract with the consultanting company
- 2007: design stage and project defining documents
- 2008: construction of the facility
- 2008-2009: commissioning and qualification
- 2009: end of stage one (until PQ)
- 2009-2010: stage two

Inspection observations

Ritva Haikala, Fimea

Applications of single-use systems and technologies in biopharmaceutical processes

Bruce Rawlings, Pall Life Sciences

The presentation will provide an overview of the current technologies and approaches most widely implemented within industry in the field of single-use systems. Furthermore, we will show real examples of specific applications including the benefits of implementation from the end-users perspective. A short review of other key areas will also be discussed such as regulatory position, challenges for implementation and key considerations prior to implementation.

Finally we will present an outlook for the future trends and requirements for single-use systems.

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Isolator for sterility testing operation: Process description and Validation

Kasper Carlsen, Life Science, Getinge

This lecture embraces a process description and an informative case describing validation of an isolator for a new installation for sterility testing validated recently. The lecture will also include a description of the practical challenges related to sterility testing operations as well as regulatory requirements. The purpose of the lecture is to present the problems that need to be addressed in the aseptic handling, the reasons to choose an isolator among different alternatives, a description of the installation and daily handling of the samples. Finally the presentation will exemplify a step-by-step validation. The method of validation comprises activities as BI's, smoke study, and cycle performed with an empty chamber as well as PQ with a defined load.

Key features of the installation and validation will be clarified; dedicated bio-decontamination unit, Rapid transfer systems, particle counter and air sampling.

IMD Technology with an example of a successful application

Gilberto Dalmaso, A & L Co Ind. Srl

Risk management in Pharma and Medical Device industry

Pasi Grönroos, PG Quality Oy

Risk management in Pharmaceutical industry and Medical Device industry is acting very important role nowadays. It is not easy to use risk management as a development tool nor to understand its' real purpose. Risk management is used to improve safety and at the same time to reduce or even eliminate any possible risks that could cause harm to the patient, user or third party.

In this section risk management will be handled from the following views:

- Risk management - Why?
- Risk management - What?
- Risk management - When?
- Risk management - How?
- Risk management as a process
- An example of risk management in cleanroom

A Comparison Study of Sampling Equipment

Bengt Ljungqvist and Berit Reinmüller, Building services Engineering, KTH

A comparison of data acquired from simultaneous measurements by IMD-A, standard OPC and STA-sampler during evaluations in a test chamber will be presented. Pros and cons of different instruments will be discussed.

Alternative method for airborne contamination control in only few hours

Diane de Pastre, Bertin Technologies

In the context of environmental contamination control and especially of air control in cleanrooms, Bertin Technologies (France) has developed a technology dedicated to the monitoring of airborne bio-particles. The goal is to propose a sampling method compatible with Rapid Microbiological Methods in order to get reliable and specific data on airborne biological agents and go beyond impaction method limits.

With this cyclonic technology, airborne particles are separated from the air and collected into a sterile liquid media. This liquid sample is directly compatible with rapid analysis such as immunoassay, PCR assay, phase cytometry and also standard culture methods. This sampler is validated according ISO14698-1 (Health Protection Agency HPA, Porton Down, UK).

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This technology aims at going beyond the traditional impaction method (impaction on agar plates) in terms of time-to-result, more information than only cultivable flora (VNC, viruses, allergens) and no saturation of the collection media.

With the Coriolis(r) technology, many studies have been carried out for the sampling of airborne bio-particles in hospitals, pharmaceutical, food and biotech industries to detect bacteria, virus, pollens, allergens or non-cultivable pathogens with alternative methods (Pneumocystis, Aspergillus, Respiratory Syncytial Virus (RSV), bacteriophage, Legionella, Stachybotrys chartarum).

Changes affecting EU GMP and the FDA's CGMP Non-viable particle cleanliness in cleanrooms

Tony Harrison, UK Technical Expert ISO TC209 WG 01 - Non-viable Contamination; Convenor ISO TC209 WG 02 - Biocontamination; Technical Expert BSI LBI/030 - Cleanrooms; Vice Chairman, UK Pharmaceutical Healthcare Sciences Society

EU GMP and the FDA's CGMP set the target cleanliness levels for non-viable particles in pharmaceutical cleanrooms. Both documents refer the reader to ISO 14644 for the methods to determine these cleanliness levels. ISO 14644 is currently under revision and the ISO Technical Committee has assigned a Working Group to make recommendations as to how the inappropriate statistical analysis tools in the current document can be improved. In addition to this focus, the new ISO 14644 will direct users to use the already existing but little-known standard for calibration and verification of air particle counters, ISO 21501-4. Cleanroom owners and classification companies would be well advised to consult their air particle counter and cleanroom monitoring system supplier(s) in order to determine the potential modifications required to comply with these changes affecting compliance to EU GMP and the FDA's CGMP.

Title to be announced

Ann-Charlotte Merkel, BD Diagnostics

ELECTRONICS

Control of macroparticles in a clean manufacturing environment

Pasi K. Tamminen, NOKIA Corporation

Macroparticles having an equivalent diameter greater than 5_μm have to be under control when products with high visual quality are manufactured. Large size particles are also challenging for joint technologies where joint thickness is less than tens of microns. This paper presents control and measurement methods to assess risks macroparticles can create in manufacturing.

Changes to ISO 14644 for Cleanrooms

Tony Harrison, HACH

ISO 21501(5) is a new family of standards describing the instruments and calibration requirements for determining particle size distribution using light interaction methods. It represents the culmination of work by instrumentation manufacturers and industry users and comes at a critical time for the life sciences industry with the increasing trend for real-time air particle monitoring in clean rooms using light scattering air particle counters.

Nano- and micro structured plastic thin film for optical and functional surface applications

Samuli Siitonen, Nanocomb Oy

Lower energy consumption, longer lifetime, smaller size and greater reliability of lighting applications are features which can be implemented by using modern LED lens structures for devices and general lighting. Typically, if illumination is created by LEDs, a powerful collimation or balance lens are necessary in lighting modification. Nano- and micro structured lens enable power-efficiency and cost-efficiency solutions for large application environment

Special design know-how combined with a high-level experience in nano- and micro lithographic and tooling processes allow producing customized flat plastic lens structures for devices and general lighting. A full mass production capability of reel-to-reel UV embossing, provides the entire supply chain from design to production of thin foil type optical components.

High volume production capacities provide also manufacturing of functional surfaces on cost-effective plastic foil. The main functional specifications of these surfaces are non-reflecting and dirt resistant properties by controlling the structure and the chemistry of the surface. The toughness and abrasion resistance of structured surfaces can be modified by using nano- and microstructures and material features.

FOOD

VTT's renovated pilot plant facilities – New possibilities for cleaner food processing and research

Juhanni Sibakov, VTT

Environmental Listeria Plate Petrifilms in detection of Listeria species from environmental samples

Liina Kutsar, Tallinn University of Technology; Satu Salo & Gun Wirtanen, VTT Expert Services Ltd

Food safety and high hygiene level is one priority to food manufactures. Petrifilm Environmental Listeria (EL) plates are designed to analyze environmental samples and to aid in efficient hygiene monitoring of food processing plants. The Petrifilm EL plate is designed to detect the majority of environmental Listeria e.g. *Listeria monocytogenes*, *Listeria innocua*, and *Listeria welshimeri*. The presence of *L. innocua* provides evidence that environmental conditions are suitable for the occurrence of *L. monocytogenes*. *L. ivanovii*, *L. grayi/murrayi* and *L. seeligeri* should also grow on EL Petrifilms but they do not form typical colonies. In practice EL Petrifilms were used in a cluster hygiene survey carried out within the SAFOODNET-project (FP6-022808-2006) in 2009. The results obtained with EL Petrifilms were confirmed using verification test mentioned in the ISO-standard method. Pure cultures of different *Listeria* species were also used on EL Petrifilms. In addition some of the samples were contaminated with milk residues in combination with several mixtures of *Listeria* species. The results of these tests showed some *Listeria* species formed atypical colonies on the EL Petrifilms. Furthermore, the tests also showed that milk residues affected the occurrence of typical colonies on EL Petrifilms. The results of this study including interpretation obtained from 3M will be discussed at this presentation.

Complementary assay in hygiene testing - chemical residue test

Juha Lappalainen, Aboatox Oy

Introduction

Disinfection is required in food plant operations where wet surfaces provide conditions for the growth of microbes. The intention is to minimize the risk of spoiled products caused by pathogens or other harmful microbes. The hygienic status of the production lines is measured with different methods like plate count techniques, ATP test and protein residue test. Traces of detergents can be present when samples for the hygiene monitoring are collected. These traces can interfere with the hygiene monitoring methods resulting in false negative results. Prolonged exposure to a detergent or disinfectant leads also to resistance by the micro organisms to the cleaning chemical used. For these reasons the food industry should pay more attention to the monitoring of detergent residues.

Hygiene test performance

There is very little published data available about the potential measurement errors with the hygiene monitoring methods used in the food industry. The ease of use and the test price are often two most important features of the tests and scientific research is focused on comparison of the different method results rather than pointing out specific sources of errors. Unfortunately ease of use means very often that a system that works well in optimal conditions but may not perform as well on the day to day conditions. The tests have been modified during the years to reduce the measurement errors. In the contact plate count methods different neutralizers have been added to the medium. However, it is well known that there is not a universal neutralizer. The systems work with some chemicals and with some organisms but not with all simultaneously. In the ATP method at least one manufacturer uses genetically modified luciferase enzyme that is more resistant to tensides (a common detergent or disinfectant) and this makes the test more reliable. In general, not a single system can work perfectly if the chemical residue concentration in the sample reaches the ready-to-use concentration of the detergents and disinfectants. To prevent the errors in hygiene monitoring the authorities have instructed not to leave any residues on the surfaces prior to starting the production but the testing instructions are not so clearly defined.

Prevention of measurement errors

With the cultivation method it is very laborious and complicated to prove the presence of the chemicals on the production surfaces. With luminescence ATP method it is fairly simple and therefore it is somewhat strange that this has not been adopted in the quality control programs. In this system ATP standard is added to the measurement mixture after the sample measurement and the performance of the reagent is tested in each sample tube.

If cultivation method is used or the ATP test system can not be used with the standard addition system there is another way to easily determine the presence of the residues: the photobacteria test. The sample surface is swabbed and the inhibition of the light output of luminescent bacteria is measured after a short contact with the swab. The result is compared to the result obtained with a clean water sample. If the light output of the sample has reduced more than 50 % compared to the control sample the surface contains significant amounts of residues and should be washed or rinsed again.

Conclusions

The cleaning and disinfection in the food industry is carried out in order to produce safe products with long shelf life. The microbiological cleaning is followed regularly and therefore it would be of great importance that the performance of the methods is also followed and the assumption of "clean status" is not derived by measurement error. The freedom from the risk of chemical residues that are not allowed in any quantity prior starting the production is not achieved by cleaning instructions only. Reliable methods to detect residues are also needed and the risk of producing resistance by the micro organisms to the cleaning chemical used can be minimized.

Maintaining a spore free cleanroom

Karen Rossington, Shield Medicare - a division of Ecolab

The manufacture of sterile pharmaceutical products is governed in the European Union by the requirements of EU Good Manufacturing Practice for Medicinal Products. The cGMP guide gives very specific details on the environmental and microbial requirements for aseptic processing. However, little or no guidance is given on how to create and maintain the correct level of microbial contamination in the aseptic suite.

One of the most difficult requirements in a life science cleanroom is the control of bacterial spores. They can enter the cleanroom on people and on components at a surprisingly high rate. Research has shown that 40% of consumables, as they are taken from stores, are contaminated with bacterial spores.

This presentation focuses on two important issues - creating and maintaining a spore-free environment and preventing spore contamination that may result from the use of disinfectants. The presentation will look at the GMP requirements that are relevant to contamination control, different sporicidal disinfectants, sporicidal test methods, details of transfer disinfection and good hand hygiene techniques.

Laboratory study of garment treatment using ozone

Savvas Yennaris, Veterinary Services

Ozone has well-documented bactericidal properties, can be generated cheaply, and although toxic, rapidly dissociates to oxygen. Thus, as a decontamination agent, gaseous ozone offers potential advantages over chlorine-releasing agents and other disinfectants. The use of gaseous ozone is increasingly being employed in many areas where decontamination of surfaces and materials is necessary.

The use of ozone in food industry has developed extensively and is used either in combination with other methods or on its' own both in gaseous form or dissolved in water. Further work is needed in order to optimize its' use and overcome the difficulties caused by the potential toxicity of ozone when inhaled and its' oxidizing potential. However, ozone is considered an environmentally friendly method and should gradually replace other methods used so far in order to improve the hygienic state of equipment and extend products' shelf life.

This study investigates the potential use of ozone as a practical way to decontaminate garments used in food industry by reducing the number of microorganisms present on them. For the purpose of the study we used garments made of three different types of material (PE/Cotton). These garments used in the food and pharmaceutical industry were provided and washed by Berendsen Textil Services. The garments were contaminated using four different types of microorganisms (*Listeria monocytogenes*, *Bacillus cereus*, *Salmonella enterica* subsp. *enterica* serotype, *Aspergillus niger*) and two different kind of soiling material (blood and nutrient broth). Contaminated garments were then treated using the ELOZO DH400(tm) ozone chamber using three different protocols.

Results indicate that ozone treatment of such garments can be an efficient way to reduce their contamination load and therefore minimize the transfer of pathogenic microorganisms in food during processing and handling. The amounts of all four types of microorganisms were reduced and in many parameter combinations even destroyed totally in the ozone chamber. Significant differences were observed between blood soiled and nutrient broth soiled sleeves since the organic material (blood) had reduced the killing effect of ozone. The general outcome was that, although ozone treatment can not replace the conventional washing of heavily contaminated clothes with high levels of organic debris, it can be used to disinfect 'clean' clothes and reduce the level of microorganisms to a safer level during the working day. It is necessary to optimize the treatment protocol (ozone levels and duration) for best results.

HEPA filter integrity testing: ISO 14644-3 and real practice

Alexander Fedotov, Invar-Project

Standard ISO 14644-3 "Cleanrooms and associated controlled environments - Part 3: Test methods", Annex B.6, describes procedure of installed HEPA filter integrity testing. But in fact this procedure is overcomplicated and requires operations that are not necessary for common practice of cleanroom testing. Nobody follows this procedure that is more theoretical than practical. One should clearly define what is necessary for research purposes, manufacturers of filters or testing equipment and for wide practice of cleanroom qualification. It is necessary to consider difference between automatic and manual methods of sampling. Presentation discusses the practical approach of cleanroom HEPA filter on-site testing and gives a simple method for it. There is nothing new in this method. It summarizes with simple words what testing engineers should really do.

Title to be announced

Patrik Bengtsson, Brookhaven

Design of Purified Water System and its Sampling for Modern On-line Analysing Technology

Christoffer Meyer, Millipore A/S

Purified Water (PW) is the most important reagent in a laboratory. In order to finally have a solution that fulfills all requirements from users or authorities there are many aspects that need to be taken into account. This presentation goes briefly through some of very basic elements that should be predefined before design can actually take place: standards from application, selection of technology, material selection, PW storage and distribution, monitoring, qualification/validation needs specification and so on.

How to clean clean?

Leila Kakko, Tampere University of Applied Sciences

Cleaning the cleanrooms is an essential element of contamination control. Decisions need to be made about the details of cleanroom maintenance and cleaning. Cleaning of a cleanroom should be performed on a daily basis. Improper cleaning of the cleanroom can lead to contamination and a loss in end user product quality. Proper selection of equipment and materials is important for proper cleaning.

Only products that have proven cleanroom performance records should be considered for use in cleanrooms. Applications and procedures need to be written and agreed upon by cleanroom management. There are many problems associated with cleaning like; who should do the cleaning, when should it be done, how often and when? All these questions should be answered and taken care of before good product quality can be reached. But first have to be decided how clean the facility have to be and how it should be measured. New cleanrooms should be designed around to make them easier to clean. It makes them cheaper to maintain.

Clean room design and construction

Jukka Vasara, Granlund Kuopio Oy

One of the most important factors affecting clean room functionality is the design process. Co-operation between users and the design team is a key factor. Main lecture topics: cleanroom definition, cleanroom classifications, cleanroom layout design, cleanroom construction, cleanroom ventilation, cleanroom pipework design, cleanroom lighting and power supplies, automation and monitoring, and different approaches to cleanroom construction. Illustration of a design gives users an opportunity to understand their role in the design process and their effect on the final product.

Examples of recently designed cleanrooms.

High Tech Hospital

Salme Nurmi, VTT

Hygiene, holistic management has become an important component of a comprehensive health care, infectious disease prevention and resolution. MRSA spread of record in 2008 and it still caused a nation-wide problem is a serious threat to Finnish health care. In Finland, hospital infections annually cause an estimated 1500 deaths and the management of 195-492 million euros in additional costs. One infection per case treatment cost increase is in the United States and Great Britain, 9400 EUR 3700 EUR. In Finland, only the surgical wound infections in operating expenses for the years 1988-90 was 200 million euros. (Finnish Medical Journal 18-19/2008 vsk 63). Previous estimates of nosocomial infections caused by the additional costs at the European level are the tens of billions of euros annually. Prevention of hospital infections is estimated to be economically profitable one preventive health-care activities.

Better economic and therapeutic outcome in the health sector is needed to reach new solutions that improve productivity and develop financial and human resources. This requires technology to large-scale systemic innovation, ie, a completely new types of approaches that affect the sector deeper practices of all actors. Demanding high-care hospital hygiene measures designed to ensure medical personnel are healthy and safe working conditions and promote the patient's healing process.

Clothing Systems in Operating Rooms - A question of Patient Safety

Bengt Ljungqvist and Berit Reinmüller, KTH, Jan Gustén, CTH and Johan Nordenadler, Projektengagemang AB.

The number of airborne bacteria carrying particles in the operating room is considered an indicator of the risk of infections to the operating patient. Today when the supply air in the operating room is HEPA-filtered, the main source of microorganisms is people (patient and personnel). The filtration efficacy of the fabric in operating clothing system plays an important role. The design of the clothing system also affects the number of particles generated from people to the air of the operating room.

In ultraclean operating rooms, the selection of clothing systems for the operating personnel can no longer be thought of in terms of comfort but in terms of patient safety.

Examples of clothing systems evaluated in a body-box test chamber and in operating rooms will be presented. The expected influence of different clothing systems in the operating room with different air volume flows will be discussed.

Contamination Risks due to Door Openings in Operating Rooms

Bengt Ljungqvist and Berit Reinmüller, KTH, Jan Gustén, CTH, Linda Gustén, Västfastigheter and Johan Nordenadler, Projektengagemang AB.

In view of the ongoing discussions concerning the need of guidelines and contamination control in operating rooms, dispersion of airborne contaminants through door openings is discussed in this paper.

Some mathematical models are described. The increase of the concentration of viable particles is predicted. The results show the importance of air cleanliness outside the operating room door in connecting areas/rooms when operations susceptible to infections are performed.

Some observations on the impact of clothing systems on the concentration of airborne particles during surgery

Jonas Hallberg Borgqvist, Building Services Engineering, KTH

In the view of the increasing number of resistant bacteria in hospitals, the effect of different operating room clothing systems on air cleanliness during surgery has been discussed.

To investigate how clothing systems of cleanroom quality affect the number of airborne bacteria-carrying particles in comparison to ordinary surgical clothing systems, tests have been performed in a test chamber (body-box) and in an operating room during surgery.

The results show that as well mechanical ventilation as clothing systems have an effect on the concentration of airborne bacteria-carrying particles, where the choice of clothing system can play an important role for the safety of the patient.

Hygiene Monitoring with the Portable Microbe Enrichment Unit (PMEU)

Elias Hakalehto, Dep. of Biosciences, Univ. of Eastern Finland

The PMEU (Portable Microbe Enrichment Unit) technology (Samplion Oy, Siilinjärvi, Finland) is a microbe cultivation method producing advantageous growth conditions for individual bacterial cells. Therefore, monitoring of bacterial populations and the presence of potential contaminants is optimised in terms of speed and accuracy. Hygienically important isolates of various bacterial strains have been cultivated aerobically, microaerobically or anaerobically using standard broth media by standard PMEU enhanced enrichment technology, or by PMEU Spectrion (r) or PMEU Scentrion (r) sensed units equipped with optical, IR, or gas sensors. The units were produced by Samplion Oy according to the ISO 9001 accepted protocol. The reference cultivations were carried out using standard microbiological procedures. The PMEU Spectrion (r) is being validated by the VTT of Finland. PMEU versions facilitated ultra-fast detection of coliformic bacteria, bacilli, salmonellas, staphylococci, streptococci, campylobacteria and other groups. The PMEU Scentrion (r) equipped with gas sensors for volatile organic compounds detected the contaminants at concentrations of bacterial levels around 10-1000 cfu/ml in 2-5 hours. Also the hospital validation studies in Austria and Finland are summarized. Moreover, The PMEU has been demonstrated to help the environmentally stressed cells to recover and become viable in the enrichment cultures. Hygiene sampling was carried out using a specific sampling syringe serving also as an incubator in the PMEU.

Cleanrooms and clean zones in hospitals

Alexander Fedotov, Invar-Project

Presentation discusses following topics:

1. Personal hygiene and air cleanliness: two necessary ways of solving the same problem.
2. Sources of microbial contamination in hospitals.
3. Particles and microorganisms in air and on surfaces.
4. Protective measures: hygiene, face masks, cleanliness of surfaces, air filtration and air exchange rate.
5. Classification of hospital rooms and requirements for air cleanliness.
6. Methods to achieve necessary level of air cleanliness for different room classes.
7. Practical examples

The effects of using a particle counter in a Cytotoxic environment. Is it dangerous for the operator?

Nikolaj Emil Damm, Holm & Halby A/S

Due to strengthen regulatives it is now mandatory for hospital pharmacies to perform continuous particle counting in the duration of their production in Class A environments. The intension of this abstract, is to focus on the possible contaminated air being sampled with a particle counter from the Bio Safety Cabinet (BSC) near the work space in a Cytotoxic environment. In order to demonstrate compliance with the standards, air is being sucked through the particle counter and into the surrounding area of the production. Often a small 0.2µ filter is installed in the counter to prevent clear contamination/exposure to the operator/surroundings. But is this safe?

There is at present two possibilities to avoid possible contamination/exposure of the operators working in the clean room. This can either be done by a build-in particle counter that has a vacuum source, often going to the void area. Exhaust air is therefore in no proximity of the personnel. Or, this can be done with a handheld particle counter placed next to the BSC, with a possibility to exhaust air via tubing directly to the ventilation system.

But is the exposure a genuine problem? In Denmark 2005 app. 200 persons is responsible for manufacturing more than 40,000 Cytotoxic treatments a year in hospital pharmacies (Estimate of 2,000 treatments per employee). Research shows that 1-9 mg/L CP was to be found in the urine of the pharmacy employees. Furthermore a Danish study of nurses, working with Cytotoxic materials showed increased risk of Leukemia and Myeloid Leukemia. Yet again, other literature claims no evidence for assessing cancer risk and acute toxicity.

An ongoing experiment led by Professor Dr. Handlos in collaboration with Holm & Halby A/S, Denmark is to determine the level of these risks. Furthermore the author of this abstract has taken the initiative via R3 Nordic, to form a European committee which purpose is to publish a Best Guide for "Particle Counting in European Hospital Pharmacy Production"

Gowning in Operating Room - Standards and experience

Dennis Andersen, De Forenede Dampvaskerier A/S

With the increased focus on hygiene in the operating room, clothing has become a major important factor. The particles and microorganisms which are released into the air in the operating room from the staff, clothing, drapes, consumables etc. should be limited in relation to the hygiene standards required during a particular infection-sensitive operation. There are now published a certain standard for barrier work suits, surgical gowns and drapes. This standard, named EN 13795, will be reviewed in relation to the analytical methods used. Meanwhile a comparative analysis of disposable items versus reusable items will be reviewed. The analysis deals with barrier properties, physical properties, environmental conditions and comfort.

Larger Climatized Zoned Ultra Clean Air will be the Future in Modern Operating Theatres

Kjell Rösjö, AET-arbetsmiljö og energiteknikk as

Ultra clean air ceilings were developed with the objective of reducing wound infections from airborne colony forming units, especially for orthopaedic surgery. Current designs confine themselves to this single objective, which has been achieved to more or less a certain degree. Infections have been reduced to low levels, however for most of the systems in use much thanks to the frequent prophylactic use of antibiotics. For many procedures the risk still are not at acceptable levels. One of the important reasons for this is the fact that the Ultra clean air ceilings until now to a certain degree helps, but not without serious compromises made by the manufacturers. The author has of this reason invented, patented and installed further significant developments of the ultra clean air ceilings. As with earlier designs, the airflow system creates a clean zone over the patient to prevent contamination. Where this theatre differs is that it comprises a number of zones where the air temperature, air humidity, air velocity, volume, direction and even cleanliness can be individually delivered and regulated manually or even automatically. The reason why the new patented technique is beneficial is that the patient, the surgeon and the anaesthetist all have conflicting requirements. The surgeon likes cool dry air for comfort. He is the one who generally dictates the theatre conditions. The anaesthetist, who is sedentary during operations finds these conditions too cold and might complain. The patient, who is the most important party present, requires to be warm in order for his body to function most effectively. Hypothermia might cause an extended serious period in getting awake and might even be deadly! Finally the patient's wound site will have temperature and humidity requirements of its own to minimise the chance of infection and to avoid evaporative cooling. The invention provides for all of these conflicting requirements. Many ceilings of this type are now in operation in Scandinavia, and are very well approved, some with a 5 year warranty of a 5 cfu limit.

The lecture Larger Climatized Zoned Ultra Clean Air will be the Future in Modern Operating Theatres will cover:

- 1) Design principles of modern Modular Laminar Air Flow Ceilings for operating Theatres, and their properties.
- 2) Systems advantages and benefits
- 3) Results compared to the traditional systems to day.
- 4) The negative sides of all types of ventilation systems for operating theatres including the conventional Laminar Air Flow systems
- 5) Risks that comes from the standard and the low velocity op-ceilings.
- 6) What can be our target! Or are you willing to be the patient or working in draft under cooled air for years ?
- 7) New fifth generation of solutions, which are at hand, solves the still existing serious problems, and can bring the negative compromises to an end.
- 8) What is really the future needs in the operating theatres. How will it be solved.

ENDING SESSION

Ergonomics and clean room work

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According to International Ergonomics Association (IEA) ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system. Ergonomics is the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Ergonomics is a multidisciplinary field that is based on physiology, psychology and technical sciences. In ergonomics, work is observed systematically, and interaction between people and work method is researched. The aim of ergonomics is to make work and work conditions correspond with physical, psychological and social qualities together with needs of the employees. As a result work ability, health and occupational competence are enhanced and maintained, as well as injuries and sick leaves decreased with the help of ergonomics. Clean room as a work environment is a challenge to ergonomics because controlled and standardized conditions. This emphasizes the importance of designing and pay attention to ergonomics during it. So far only limited information is available about this event.