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Int Arch Occup Environ Health. 2013 Jan;86(1):65-70. doi: 10.1007/s00420-012-0747-7. Epub 2012 Feb 17.

1. ### Pneumoproteins in sewage workers exposed to sewage dust.

Heldal KK[1], Barregard L, Larsson P, Ellingsen DG.

Author information

Abstract

PURPOSE: The association between exposure to bacteria and **endotoxins** in sewage dust and the serum concentrations of pneumoproteins in sewage **treatment** plant workers were studied.

METHODS: Forty-four workers from eight sewage **treatment** plants and 38 reference workers participated in the study. Microbial aerosol was collected by personal inhalable samplers. The concentrations of bacteria and **endotoxins** were determined by fluorescence microscopy and the Limulus assay, respectively. Pneumoproteins (Clara cell protein: CC16, and Surfactant proteins A and D: SP-A, SP-D) were determined by ELISA in blood samples collected post-shift.

RESULTS: The exposure to dust ranged from 0.02 to 9.3 (geometric mean (GM) 0.3 mg/m(3), of bacteria from 0.3 to 4,900 × 10(3) (GM 27 × 10(3)) cells/m(3) and **endotoxins** from 1 to 3,160 (GM 28) EU/m(3). The exposed workers had lower CC16 [arithmetic mean (AM) 4.9 ng/ml] compared to the referents (AM 6.4 ng/ml, $p < 0.01$). No significant difference was observed for SP-D and SP-A. Exposure to bacteria was positively associated with CC16 ($p < 0.05$) and SP-D ($p < 0.05$), adjusting for possible confounders.

CONCLUSIONS: This study showed that exposed workers had lower serum concentration of CC16 as compared to the referents, which may reflect a long-term effect on secretion of these pneumoproteins. The positive association between exposure to bacteria and the serum concentrations of CC16 and SP-D may be explained by a transient increased permeability of the lung-blood barrier.

PMID: 22350277 [PubMed - indexed for MEDLINE] PMCID: PMC3535374 **Free PMC Article**

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MeSH Terms, Substances

J Occup Environ Hyg. 2011 Mar;8(3):147-53. doi: 10.1080/15459624.2011.555256.

2. **Airborne endotoxin from indoor and outdoor environments: effect of sample dilution on the kinetic Limulus amebocyte lysate (LAL) assay.**

Dungan RS.

Author information

Abstract

Airborne **endotoxins** in occupational environments are a potential respiratory hazard to individuals. In this study, airborne **endotoxins** were collected using open-face and button aerosol samplers from inside animal housing units and downwind from agricultural production sites and a **wastewater treatment** plant. Filter extracts were then diluted to examine the effect of interfering substances on the kinetic Limulus amebocyte lysate (LAL) assay. In most cases, the overall endotoxin concentration was shown to decrease with increasing dilution up to 1000-fold, suggesting the presence of enhancing substances in the filter extracts. This dilution-dependent effect was most prominent in the open-face endotoxin samples, while button samples displayed little effect. Using a joinpoint regression model, it was determined that a dilution factor of 50 to 100 was generally sufficient to eliminate the presence of enhancing substances. After screening the data for dilution dependent effects, the airborne endotoxin concentrations were determined. The highest endotoxin concentrations, ranging from 2841 to 49,066 endotoxin units m(-3) of air, were found inside swine farrowing and finishing barns. Airborne endotoxin concentrations were 10- to 100-fold lower inside a dairy barn and downwind of other agricultural production sites and the **wastewater treatment** plant. Examination of dilution-dependent effects should be considered essential when utilizing the LAL assay, especially if values are to be used for regulatory purposes.

PMID: 21347956 [PubMed - indexed for MEDLINE]

View full text

MeSH Terms, Substances

Ann Agric Environ Med. 2008 Dec;15(2):251-61.

3. **Endotoxin exposure in sewage treatment workers: investigation of exposure variability and comparison of analytical techniques.**

Spaan S[1], Smit LA, Eduard W, Larsson L, Arts HJ, Wouters IM, Heederik DJ.

Author information

Abstract

INTRODUCTION: Objectives were to give an overview of endotoxin exposure and its determinants in sewage **treatment** workers, and to study exposure to culturable and non-culturable microorganisms and the applicability of the LAL assay in this work environment.

MATERIAL AND METHODS: In 43 **Dutch** sewage **treatment** plants 470 full-shift, 123 task-based personal and 54 stationary inhalable dust samples were collected. Endotoxin concentration was determined with the LAL-assay. Mixed effects models were used to investigate possible determinants of exposure. Simultaneous parallel filter samples, impinger samples and viable total bacteria and Gram-negative bacterial samples were taken to compare analytical techniques. Filter and impinger samples were analyzed with the LAL-assay, gas chromatography-mass spectrometry (GC-MS) and fluorescence microscopy.

RESULTS: Endotoxin exposure levels were moderate to low (geometric mean personal exposure 27 EU/m(3), stationary 33 EU/m(3), task-based 64 EU/m(3)), yet differences between jobs and sources and some determinants of exposure were identified. Exposure varied more from day to day than between workers. Concentrations in filter samples were higher and more consistent than in impinger samples. Fungi and Gram-positive bacteria were found in higher levels than Gram-negative bacteria. The LAL assay and GC-MS showed comparable endotoxin levels.

DISCUSSION AND CONCLUSION: Endotoxin exposure in **Dutch** sewage **treatment** workers was relatively low. Comparison of sampling and analytical techniques suggests that the LAL-assay did not result in much exposure misclassification. It thus seems justified to perform filter measurements in combination with the LAL-assay to measure endotoxin exposure in sewage **treatment** plants.

PMID: 19118445 [PubMed - indexed for MEDLINE] **Free full text**

AAEM FULL TEXT

Publication Types, MeSH Terms, Substances

J Occup Environ Med. 2007 Nov;49(11):1235-48.

4. ## Monitoring risks in association with exposure levels among wastewater treatment plant workers.

Lee JA[1], Thorne PS, Reynolds SJ, O'Shaughnessy PT.

Author information

Abstract

OBJECTIVE: To investigate the relationship between exposure to hydrogen sulfide and endotoxin during specific job tasks and health symptoms among **wastewater treatment** plant (WWTP) workers.

METHODS: The exposure levels for specific tasks were measured by personal monitoring. The health symptoms of WWTP workers were compared with those of **water treatment** plant workers through a questionnaire survey.

RESULTS: Exposure levels for all monitored tasks were less than 1 ppm for hydrogen sulfide and 91 EU/m (endotoxin units/m) for endotoxin. Statistically higher odds ratios of

respiratory, ocular and skin irritation, neurology, and gastrointestine symptoms were shown among WWTP workers compared with **water treatment** plant workers. Tasks related to sludge handling and plant inspection showed statistically significant associations with memory/concentration difficulties, throat irritation, and stomach pain.

CONCLUSIONS: These results suggest that exposure control programs for specific job tasks and work locations are needed.

PMID: 17993928 [PubMed - indexed for MEDLINE]

MeSH Terms, Substances

Ann Occup Hyg. 2006 Oct;50(7):731-6. Epub 2006 Jun 16.

5. ## Influence of different cleaning practices on endotoxin exposure at sewage treatment plants.

Visser MJ[1], Spaan S, Arts HJ, Smit LA, Heederik DJ.

Author information

Abstract

Exposure to endotoxin at sewage **treatment** plants is associated with an increased prevalence of **work-related** symptoms in sewage workers. Since cleaning activities are regarded as an important determinant of endotoxin exposure, workers' endotoxin exposure levels during different cleaning activities were compared in an experimental setting. Variables considered were **water** used (tap **water**, surface **water** or effluent), **water** pressure (low or high pressure, and a fire hose with the mouth open or obstructed), presence of mechanical ventilation and the distance between the worker and the object to be cleaned (concentration gradient). Experimental cleaning scenarios were defined, during which endotoxin exposure was measured with personal and stationary air sampling. Data were statistically analyzed with mixed effects models. The **water** used for cleaning appeared to have a large influence on endotoxin exposure, especially the use of effluent, which caused a factor 2.4 increase in exposure. Use of high pressure did not significantly add to the exposure. Use of a fire hose with fully opened mouth (spout opening) led to a 3-fold decrease in exposure when compared with a partially obstructed mouth. The presence of mechanical ventilation decreased endotoxin concentration in a room, provided that the capacity of the ventilation system was sufficient. The worker's distance to the object that was cleaned did not significantly influence exposure.

PMID: 16782738 [PubMed - indexed for MEDLINE] **Free full text**

MeSH Terms, Substances

J Environ Monit. 2006 Jan;8(1):43-8. Epub 2005 Sep 19.

6. **Bioaerosol sampling by a personal rotating cup sampler CIP 10-M.**

Görner P[1], Fabriès JF, Duquenne P, Witschger O, Wrobel R.

Author information

Abstract

High concentrations of bioaerosols containing bacterial, fungal and biotoxinic matter are encountered in many workplaces, e.g. solid **waste treatment** plants, **waste water treatment** plants and sewage networks. A personal bioaerosol sampler, the CIP 10-M (M-microbiologic), has been developed to measure worker exposure to airborne biological agents. This sampler is battery operated; it is light and easy to wear and offers full work shift autonomy. It can sample much higher concentrations than biological impactors and limits the mechanical stress on the microorganisms. Biological particles are collected in 2 ml of liquid medium inside a rotating cup fitted with radial vanes to maintain an air flow rate of 10 l min(-1) at a rotational speed of approximately 7,000 rpm. The rotating cup is made of sterilisable material. The sampled particles follow a helicoidal trajectory as they are pushed to the surface of the liquid by centrifugal force, which creates a thin vertical liquid layer. Sterile **water** or another collecting liquid can be used. Three particle size selectors allow health-related aerosol fractions to be sampled according to international conventions. The sampled microbiological particles can be easily recovered for counting, incubation or further biochemical analysis, e.g., for airborne **endotoxins**. Its physical sampling efficiency was laboratory tested and field trials were carried out in industrial **waste** management conditions. The results indicate satisfactory collection efficiency, whilst experimental application has demonstrated the usefulness of the CIP 10-M personal sampler for individual bioaerosol exposure monitoring.

PMID: 16395458 [PubMed - indexed for MEDLINE]

MeSH Terms, Substances

Am J Ind Med. 2005 Jul;48(1):30-9.

7. **Endotoxin exposure and symptoms in wastewater treatment workers.**

Smit LA[1], Spaan S, Heederik D.

Author information

Abstract

BACKGROUND: **Wastewater treatment** workers can be exposed to biological and chemical agents resulting in **work-related** health effects. The aim of this study was to investigate **work-related** symptoms in these workers.

METHODS: Questionnaire data of 468 employees from 67 sewage **treatment** plants is

evaluated. Personal endotoxin exposure (8 hr measurements; n = 460) was measured in a sample of workers in three different periods over 1 year.

RESULTS: Endotoxin exposure ranged from 0.6 to 2093 endotoxin units (EU)/m(3), the geometric mean exposure was low (27 EU/m(3)). Factor analysis yielded three clusters of correlated symptoms: "lower respiratory and skin symptoms," "flu-like and systemic symptoms," and "upper respiratory symptoms." Symptoms appeared to be more prevalent in workers exposed to endotoxin levels higher than 50 EU/m(3). A significant dose-response relationship was found for "lower respiratory and skin symptoms" and "flu-like and systemic symptoms" ($P < 0.05$).

CONCLUSIONS: Wastewater treatment workers reported a wide range of symptoms that may be **work-related**. Microbial exposures such as endotoxin seem to play a causal role.

PMID: 15940720 [PubMed - indexed for MEDLINE]

Publication Types, MeSH Terms, Substances

Ann Occup Hyg. 2005 Jul;49(5):393-400. Epub 2005 Feb 9.

8. ## Influence of seasons and sampling strategy on assessment of bioaerosols in sewage treatment plants in Switzerland.

Oppliger A[1], Hilfiker S, Vu Duc T.

Author information

Abstract

An assessment of sewage workers' exposure to airborne cultivable bacteria, fungi and inhaled **endotoxins** was performed at 11 sewage **treatment** plants. We sampled the enclosed and unenclosed **treatment** areas in each plant and evaluated the influence of seasons (summer and winter) on bioaerosol levels. We also measured personal exposure to **endotoxins** of workers during special operation where a higher risk of bioaerosol inhalation was assumed. Results show that only fungi are present in significantly higher concentrations in summer than in winter (2331 +/- 858 versus 329 +/- 95 CFU m(-3)). We also found that there are significantly more bacteria in the enclosed area, near the particle grids for incoming **water**, than in the unenclosed area near the aeration basins (9455 +/- 2661 versus 2435 +/- 985 CFU m(-3) in summer and 11 081 +/- 2299 versus 2002 +/- 839 CFU m(-3) in winter). All bioaerosols were frequently above the recommended values of **occupational exposure**. Workers carrying out special tasks such as cleaning tanks were exposed to very high levels of **endotoxins** (up to 500 EU m(-3)) compared to routine work. The species composition and concentration of airborne Gram-negative bacteria were also studied. A broad spectrum of different species within the Pseudomonadaceae and the Enterobacteriaceae families were predominant in nearly all plants investigated.

PMID: 15703283 [PubMed - indexed for MEDLINE] Free full text

Publication Types, MeSH Terms, Substances

Ann Agric Environ Med. 2004;11(2):199-204.

9. **Health complaints from workplace exposure to bioaerosols: a questionnaire study in sewage workers.**

Krajewski JA[1], Cyprowski M, Szymczak W, Gruchala J.

Author information

Abstract

A questionnaire study was performed in 99 workers at a large sewage **treatment** plant to investigate self-reported health complaints from workplace exposure to bioaerosols. The study population was divided into subgroups according to different work stations: mechanical **treatment** (MT), biological **treatment** (BT), sewage sludge **treatment** (SST) and operation control (OC). The questionnaire included personal data, workpost and job characteristics, exposure to chemicals, history of employment and exposure, workplace hygiene and protective measures, smoking and drinking habits. There was also a series of 25 questions on subjective health complaints grouped into the following clusters: 'flu-like symptoms', 'respiratory symptoms', 'nose, eye, throat and skin irritation', 'neurological symptoms' and 'gastrointestinal symptoms'. Each subject was asked whether the complaints had occurred 'frequently', 'rarely', or 'never' within the previous 12 months. Air concentrations of **endotoxins** and (1 --> 3)- beta-D-glucans in the worker's breathing zone were also determined. The measurements of concentrations were made in the summertime during a morning shift. To determine **endotoxins** concentration, the Chromogenic Limulus Amebocyte Lysate (LAL) Test was applied. The questionnaire data and determination results were subject to a statistical analysis. No statistically significant relationship was found between the reported health complaints and such variables as job title, exposure to **endotoxins** and glucans, tobacco smoking, age and period of employment as sewage worker. The findings revealed that among the complaints, muscle and joint ache was reported most frequently, while among the symptom clusters, the flu-like symptoms prevailed. These symptom clusters occurred most frequently in OC workers, and were least often found in SST workers. In the worker's breathing zone, the geometric mean concentration of **endotoxins** amounted to 20.3 ng/m3 and of glucans to 7.76 ng/m3, and was not related to job title or job characteristics. A high correlation was found between **endotoxins** and (1 --> 3)- beta -D-glucans concentrations (Pearson correlation coefficient 0.86, $p < 0.0005$).

PMID: 15627324 [PubMed - indexed for MEDLINE] Free full text

Publication Types, MeSH Terms, Substances

Int J Occup Environ Health. 2004 Jan-Mar;10(1):84-9.

10. **Work-related symptoms and inflammation among sewage plant operatives.**

Thorn J[1], Beijer L.

Author information

Abstract

Sewage operatives at five sewage **treatment** plants (n = 59) and controls not exposed to sewage (n = 55) were examined to determine **work-related** symptoms and inflammatory responses. Symptoms were elicited using a questionnaire, and spirometry was performed. Inflammatory markers were determined in blood and nasal lavage. Workplace endotoxin and hydrogen sulfide were measured and adeno- and enterovirus antibodies were evaluated in blood. Gastrointestinal and airway symptoms, joint pains, unusual tiredness, and toxic pneumonitis were more common among operatives, and the proportion of blood neutrophils was higher among operatives as compared with controls. A relationship was found between several reported symptoms and the inflammatory markers. Hydrogen sulfide levels were very low. Endotoxin levels were generally low, but high at some work sites.

PMID: 15070030 [PubMed - indexed for MEDLINE]

Publication Types, MeSH Terms, Substances

Ann Agric Environ Med. 2003;10(2):241-8.

11. **Exposure to bioaerosols in a municipal sewage treatment plant.**

Prazmo Z[1], Krysinska-Traczyk E, Skorska C, Sitkowska J, Cholewa G, Dutkiewicz J.

Author information

Abstract

Microbiological air sampling was performed in a medium-size sewage **treatment** plant processing municipal **wastewater** from a city located in eastern Poland. Air samples for determination of the concentrations of viable mesophilic bacteria, Gram-negative bacteria, thermophilic actinomycetes, fungi and endotoxin were collected at 12 sites associated with various phases of sewage **treatment** process. The concentrations of total mesophilic bacteria (both Gram-positive and Gram-negative) were within a range of 2.4-70.7 x 10(2) cfu/m(3). Gram-positive coryneform bacteria and cocci were dominant, forming respectively 56.6 % and 24.0 % of the total count. The concentrations of Gram-negative bacteria, thermophilic actinomycetes, and fungi were respectively within ranges of 0.2-5.7 x 10(2) cfu/m(3), 0-0.5 x 10(2) cfu/m(3), and 0.24-1.4 x 10(2) cfu/m(3). Among Gram-negative

bacteria, commonly occurred Enterobacter cloacae (17.3 % of the total count), followed by Acinetobacter calcoaceticus (16.2 %), Pseudomonas spp. (14.0 %) and Stenotrophomonas maltophilia (11.1 %). Among thermophilic actinomycetes prevailed Thermoactinomyces thalpophilus (47.2 %) and Thermoactinomyces vulgaris (22.2 %), while among fungi, Geotrichum candidum (32.2 %), Penicillium spp. (20 %), Cladosporium lignicola (12.2 %), and Alternaria alternata (10.4 %). Altogether, 20 potentially pathogenic species or genera of bacteria and fungi were identified in the air samples taken in the examined plant. The values of the respirable fraction of airborne microflora varied within a fairly wide range and were between 24.1-100 %. The concentrations of airborne endotoxin were in the range of 0.104-5.2 ng/m(3). In conclusion, the concentrations of microorganisms and endotoxin in the examined municipal sewage **treatment** plant were low and did not exceed proposed **occupational exposure** limit values. A moderate risk for the workers may be associated with the presence of potentially pathogenic microbial species having allergenic and/or immunotoxic properties.

PMID: 14677919 [PubMed - indexed for MEDLINE] Free full text

MeSH Terms, Substances

Can J Microbiol. 2002 Aug;48(8):681-96.

12. ## Bioaerosols from municipal and animal wastes: background and contemporary issues.

Pillai SD[1], Ricke SC.

Author information

Abstract

Global population increases, coupled with intensive animal and livestock production practices, have resulted in the generation, accumulation, and disposal of large amounts of wastes around the world. Aerosolization of microbial pathogens, **endotoxins**, odors, and dust particles is an inevitable consequence of the generation and handling of **waste** material. Bioaerosols can be a source of microbial pathogens, **endotoxins**, and other allergens. Given the close proximity of population centers to concentrated animal-rearing operations and municipal **treatment** facilities in many parts of the world, there is concern regarding the occupational and public health impacts associated with the exposure to bioaerosols from municipal and animal wastes. Major advances have been made in our understanding of bioaerosol characteristics, identifying the hazards, and identifying possible human and animal health links with aerosolized pathogens and allergens. However, significant knowledge and technology gaps still exist. These include a lack of clear understanding of the fate and transport of bioaerosols, especially within the open environment, an inability to accurately predict the health risks associated with bioaerosolized pathogens, and a lack of standardized bioaerosol sampling protocols, and efficient samplers. This review synthesizes the information related to bioaerosols and

addresses the contemporary issues associated with bioaerosols from municipal and animal wastes, with a focus on pathogens.

PMID: 12381025 [PubMed - indexed for MEDLINE]

Publication Types, MeSH Terms, Substances

Bull Environ Contam Toxicol. 2001 Aug;67(2):171-8.

13. **Exposure to endotoxins and microbes in the treatment of waste water and in the industrial debarking of wood.**

Sarantila R[1], Reiman M, Kangas J, Husman K, Savolainen H.

Author information

PMID: 11429673 [PubMed - indexed for MEDLINE]

SpringerLink FULL-TEXT ARTICLE

Publication Types, MeSH Terms, Substances

Ann Agric Environ Med. 2001;8(1):39-45.

14. **Work-related symptoms in sewage treatment workers.**

Douwes J[1], Mannetje A, Heederik D.

Author information

Abstract

The aim of this study was to investigate health symptoms in sewage **treatment** workers. A health questionnaire was distributed among 147 sewage **treatment** workers. Correlating symptoms were clustered using principal component analysis and the association with self-reported exposure was assessed by calculating prevalence odds ratios (OR). Endotoxin was measured in two **treatment** plants. Personal endotoxin exposure was low (<10 Endotoxin Units/m(3)). Factor analysis of 29 symptoms resulted in four clusters of highly correlating symptoms: 'flu-like symptoms'; 'higher airway symptoms'; 'lower airway symptoms'; and 'neurological symptoms'. These clusters were positively associated with working with sewage, but only significant for 'flu- like symptoms' (OR=5.0; 95%CI=1.4-17.6; p<0.05) and 'neurological symptoms' (OR=4.2; 95%CI=1.5-11.7; p<0.01). Chemical exposure was associated with 'neurological symptoms' (OR=8.4; 95%CI=1.1-65.7; p<0.05). The use of daily washed working clothes was negatively associated with 'flu-like symptoms' (OR=0.3; 95%CI=0.1-0.6; p<0.01). In conclusion, sewage **treatment** workers develop a large variety of **work-related** symptoms that are not likely caused by endotoxin exposure only. Good hygienic practice at the workplace may prevent some of these symptoms

PMID: 11426923 [PubMed - indexed for MEDLINE] **Free full text**

Publication Types, MeSH Terms, Substances

Occup Med. 2001 Jan-Mar;16(1):23-38.

15. ## Sewage workers: toxic hazards and health effects.

Mulloy KB.

Author information

Abstract

Municipal sewage workers provide an essential service in the protection of public health. The **wastewater treatment** process brings the worker in contact with multiple pathogens, toxic gases, chemicals, and physical hazards. Issues such as the prevalence of hepatitis A among **wastewater treatment** workers in the U.S. have not been well studied. There remains a controversy on the need to offer hepatitis A pre-exposure immunization. Health effects to some exposures, such as gram-negative bacteria and **endotoxins**, have been well studied among other workers, and preventive measures, such as permissible endotoxin levels, that have been established for these workers should be adopted for the **wastewater treatment** environment. Further study into **mortality** and morbidity rates among sewage workers and the relationship to exposures and the development of preventive measures is needed.

PMID: 11107222 [PubMed - indexed for MEDLINE]

Publication Types, MeSH Terms, Substances

Occup Environ Med. 1999 May;56(5):354-7.

16. ## Health effects among workers in sewage treatment plants.

Rylander R.

Author information

Abstract

OBJECTIVES: To further assess the presence of fatigue, symptoms of diarrhoea, and inflammation of airways among people working in sewage plants and the relation to airborne bacterial endotoxin at the workplace.

METHODS: 34 Employees in sewage **treatment** plants and 35 controls were selected. They underwent a questionnaire investigation, and spirometry and airway responsiveness were measured. Measurements were made of airborne endotoxin at different workplaces.

RESULTS: The amount of airborne endotoxin varied between 3.8 and 32,170 ng/m3. Workers reported significantly higher nose irritation, tiredness, and diarrhoea. Airway responsiveness was increased among sewage workers, but no differences between the

groups were found for spirometry.

CONCLUSIONS: The results confirm previous studies on the presence of airways and intestinal inflammation among workers in sewage **treatment** plants. The most likely causative agent is endotoxin, and at 14 of 23 workplaces, concentrations exceeded recommended guidelines.

Comment in

Health effects among workers in sewage **treatment** plants. [Occup Environ Med. 1999]

PMID: 10472311 [PubMed - indexed for MEDLINE] PMCID: PMC1757741 **Free PMC Article**

Publication Types, MeSH Terms, Substances

Ann Agric Environ Med. 1999;6(1):33-8.

17. ## Importance of sampling, extraction and preservation for the quantitation of biologically active endoto.

Laitinen SK.

Author information

Abstract

The influence of filter media, extraction solution and preservation method on detection of biologically active endotoxin in the LAL assay was studied with air samples collected from **wastewater treatment** plants. The four most common types of filters were used as collection media. The extraction solutions compared were nonpyrogenic **water**, KH2PO4-triethylamine and Trizma buffers. The effect of preservation on endotoxin air samples was ascertained by storing both the filters without extraction, and samples extracted in the collection day for a few weeks at various temperatures. Samples collected on glass fibre filters showed the highest amounts of detectable endotoxin, while the concentrations of endotoxin were significantly lower when cellulose-mixed esters, polycarbonate or polyvinyl chloride membrane filters were used for air sampling. After collection, the best efficiency for glass fibre filters was attained by extraction with nonpyrogenic **water** within 8 hours after sampling and storage of the extracts at 4 degrees C until they were analysed. If the filters were stored without extraction, the reduction in endotoxin levels of the sample was about 30% after 1 week preservation and about 70% after 2 weeks. The study shows that the effect of the filter material and preservation practice was significant. These factors play critical roles in assessing exposure to bacterial **endotoxins** within **wastewater** aerosols.

PMID: 10384213 [PubMed - indexed for MEDLINE]

Publication Types, MeSH Terms, Substances

Am Ind Hyg Assoc J. 1994 Nov;55(11):1055-60.

18. **Workers' exposure to airborne bacteria and endotoxins at industrial wastewater treatment plants.**

Laitinen S[1], Kangas J, Kotimaa M, Liesivuori J, Martikainen PJ, Nevalainen A, Sarantila R, Husman K.

Author information

Abstract

A study of sewage workers' exposure to airborne culturable bacteria and inhaled **endotoxins** was performed at nine **waste-water treatment** plants that treat mainly industrial effluents. Airborne **endotoxins** were collected on glass fiber filters and analyzed using a chromogenic limulus assay. Endotoxin concentrations measured in the immediate vicinity of the **waste-water treatment** process varied from 0.1 to 350 ng/m3. The eight-hour time weighted average concentrations of endotoxin to which workers were exposed exceeded the suggested exposure limit (30 ng/m3 endotoxin) at four of the plants. Air samples of culturable bacteria concentrations varied between 10 and 10(5) colony-forming units/m3. Of the particles carrying culturable bacteria, 88% had an aerodynamic diameter of less than 4.7 microns. The most common genera of airborne gram-negative bacteria were acinetobacter, citrobacter, enterobacter, klebsiella, and pseudomonas. High levels of exposure to bacteria and bacterial endotoxin usually were related to certain phases of the **treatment** process. The microbiological contamination of air was highest near the inlets where incoming **wastewater** entered the basins, in the sludge **treatment** area, and inside the biofilter tower. In these spaces it is necessary to control and reduce exposure to airborne bacteria and endotoxin at **wastewater** plants.

PMID: 7992797 [PubMed - indexed for MEDLINE]

Publication Types, MeSH Terms, Substances

Am J Ind Med. 1994 Jan;25(1):125-7.

19. **Microbiological treatment of recirculating wastewater from cleaning rolls in a rolling mill.**

Lundholm M[1], Grönqvist B.

Author information

Abstract

In **industry**, the use of biological methods for cleaning **wastewater** is increasing. The number of airborne Gram-negative bacteria was high in relation to the use of high pressure **water** in a rolling mill using recirculated **water** for cleaning rolls. Analyzing the total amount and species of microorganisms indicates whether they are emitted from a polluted source or consist of the normal airborne flora.

PMID: 8116637 [PubMed - indexed for MEDLINE]

MeSH Terms, Substances

Schweiz Med Wochenschr. 1987 Mar 7;117(10):354-8.

20. **[Demonstration of gram-negative bacteria and endotoxins in the air surrounding a sewage treatment plant: effect of contaminated aerosols on the health status of the staff].**

[Article in **French**]
Schira JC, Snella MC, Chapon JL.

Abstract

Data on airborne gram-negative bacteria and endotoxin contamination in a sewage **treatment** plant are reported and compared with data from similar plants in Scandinavia. Respiratory, digestive, and cutaneous symptoms were investigated on the basis of medical files. The contamination levels which can be considered safe are discussed in the light of the actual exposure of workers.

PMID: 3563442 [PubMed - indexed for MEDLINE]

Publication Types, MeSH Terms, Substances

Schweiz Med Wochenschr. 1977 Feb 12;107(6):182-4.

21. **Studies on humans exposed to airborne sewage sludge.**

Rylander R, Andersson K, Belin L, Berglund G, Bergström R, Hanson L, Lundholm M, Mattsby I.

Abstract

A clinical investigation was made among workers in a sewage **treatment** plant and age matched controls not exposed to sewage. Acute incidences of fever and eye symptoms were found in about 50% of the exposed population. Serum immunoglobulins, white blood cells and thrombocytes were elevated in the exposed group. A higher percentage of increased levels of C-reactive protein and fibrinogen degradation products was found in the exposed group. Although no definite cause-effect relationship can be established the responsible agent in the environment could well be **endotoxins**.

PMID: 834990 [PubMed - indexed for MEDLINE]

MeSH Terms, Substances