ECOTOXICITY OF CHEMICALS TO PHOTOBACTERIUM PHOSPHOREUM (HANDBOOKS OF ECOTOXICOLOGICAL DATA) pdf

1: Photobacterium phosphoreum toxicity bioassay. I. Test procedures and applications - [PDF Document]

Ecotoxicity of Chemicals to Photobacterium Phosphoreum is the second volume in the series Handbooks of Ecotoxicological Data. After a brief introductory chapter on the usefulness of the MicrotoxÂ® test, toxicity results for a large collection of over a thousand chemicals are presented in unparalleled detail, thus ensuring the accuracy and.

Most widely held works by Klaus L. E Kaiser Book 20 editions published between and in English and Undetermined and held by WorldCat member libraries worldwide Structure-activity relationships for toxicity of hydrocarbons, chlorineted hydrocarbons and oils to Daphnia magna. Comparative toxicity and metabolism of tetrachlorobenzene isomers. The use of rapid biochemical indicators of toxicant stress to generate biological data bases for QSAR. Structure-activity models of biological oxygen demand. Environmental hazard profile - test results as related to structures and translation into the environment. Predicitng the environmental fate of toxic contaminants in large lakes: Assessment of mutagenic effects in amphibian embryos. Lethal dose versus lethal concentration as indicator of contaminant toxicity to fish. QSAR studies on chlorophenols, chlorobenzenes and para-substituted phenols. Quantitative structure-activity relationships in ecotoxicology: Toxicities of selected chlorianilines to four strains of yeast. Comparative structure-toxicity relationships between acute and chronic effects to aquatic organisms. Relationships between physical-chemical and environmental partitioning coefficients. Validation of fish toxicity QSARs for certain non-reactive, non-electrolyte organic compounds. The relationship between bioconcetration factor in rainbow trout and physical-chemical properties for some halogenated compounds. Toxicities of chloroanilines to Photobacterium phosphoreum and thei correlations with effects on other organisms and structural parameters. Structure-activity correlations of selected azaarenes, aromatic mines, and nitroaromatics. E Kaiser Book 11 editions published between and in English and Portuguese and held by WorldCat member libraries worldwide Over the past few years, research in the field of quantitative structure-activity relationships QSAR in chemistry, biology, pharmacology, toxicology, and environmental sciences has seen strong growth. New journals and books have appeared in each of these fields, however, the combination of QSAR and environmental sciences is still in its infancy. Moreover, both breadth and depth of papers given were significantly improved and the workshop discussions were intense and frank. Regrettably, the number of participants, number of papers given and submitted for these proceedings made it impossible to include the workshop discussions of these papers. However, several manuscripts were revised on the basis of these discussions and, therefore, do reflect this very interactive workshop. Many of these papers contain primary, new scientific data, equations and results which will not appear elsewhere Ecotoxicity of chemicals to Photobacterium Phosphoreum by Klaus L. E Kaiser Book 10 editions published between and in English and held by 74 WorldCat member libraries worldwide Convenient myths: The data are discussed in terms of contaminated sources, pathways and sinks. Spatial trends along and across the river and relationships of contaminant groups within and between compartments are investigated. The results indicated continuing inputs of all contaminant groups to the river from a variety of sources, particularly from sewage treatment plant effluents and several tributaries"--Exec. Lawrence River by Michael E Comba Book 1 edition published in in English and held by 5 WorldCat member libraries worldwide Tracking river plumes with volatile halocarbon contaminants: Claire example by Klaus L. E Kaiser 2 editions published in in English and held by 5 WorldCat member libraries worldwide "Surface water samples from Lake St. Clair and the lower St. Clair River in June were analyzed for volatile halocarbon contaminants. The results indicate major sources of carbon tetrachloride and tetrachloroethylene along the eastern shore of the St. Much smaller loadings of chloroform and associated haloforms and of trichloroethylene are contributed by several sources, including the St. E Kaiser Book 1 edition published in in English and held by 5 WorldCat member libraries worldwide Toxicity of para-chloro substituted benzene derivatives in the microtox test by Klaus L. E Kaiser 2 editions published in in English and held by 5 WorldCat member libraries worldwide "Reported are the acute toxic

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concentrations of 38 chemicals of the general formula 1-Cl-C6HX where X is a typical functional group as found in many industrial compounds. Some of the compounds are therefore closely related to important pesticidal and herbicidal chemicals. The data are discussed in terms of quantitative structure-toxicity relationships QSAR with physic-chemical paramerters"--Exec. It was found that SSDH levels in blood could: E Kaiser Book 1 edition published in in English and held by 4 WorldCat member libraries worldwide The acute toxicity of pulse-dosed para-substituted phenols to juvenile American flagfish Jordanella floridae:

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2: James Devillers - BÃ¶cker | Bokus bokhandel

Ecotoxicity of Chemicals to Photobacterium Phosphoreum (Handbooks of Ecotoxicological Data) by K. L.e. Kaiser. Routledge, Hardcover. Good.

The microplate luminometer and a kinetic Flash-Assay test format was used that differently from Microtox test is also applicable for high throughput analysis. Toxic effects s till min EC50 of four heavy metals Zn, Cd, Hg, Cu and three organic chemicals aniline, 3,5-dichloroaniline and 3,5-dichlorophenol were studied. The most toxic chemical for all used bacterial strains E. Despite of that, toxicity results obtained with both E. The use of amino acids 0. The kinetic Flash Assay test format of the bioluminescence inhibition assay facilitates high throughput analysis. The assay medium, especially in case of testing heavy metals should be a compromise: Sorry, we are unable to provide the full text but you may find it at the following location s: Suggested articles Citations A suite of recombinant luminescent bacterial strains for the quantification of bioavailable heavy metals and toxicity testing. Analysis of bioavailable phenols from natural samples by recombinant luminescent bacterial sensors. Analysis of gene control signals by DNA fusion and cloning in Escherichia coli. Aquatic multi-species acute toxicity of chlorinated anilines: Experimental versus predicted data. Assessment of heavy metal bioavailability using Escherichia coli zntAp:: Automated color correction method for Vibrio fischeri toxicity test. Comparison of standard and kinetic assays. Autonomous bioluminescent expression of the bacterial luciferase gene cassette lux in a mammalian cell line. Bacterial bioluminescence and its application to analytical procedures. In Liquid Scintillation Counting: Structure-activity relationships for prediction of aquatic toxicity. Comparison of three rapid toxicity test procedures: Microtox, polytox, and activated sludge respiration inhibition. Correlations of Vibrio fischeri bacteria test data with bioassay data for other organisms. Ecotoxicity of Chemicals to Photobacterium Phosphoreum; Handbooks of ecotoxicological data; Ecotoxicological assessment of leachates from MSWI bottom ashes. Ecotoxicological study of Lithuanian and Estonian wastewaters: Selection of the biotests and correspondence between toxicity and chemical-based indices. Ecotoxicological tests in non-ecotoxicological research: Contribution to the three Rs. Use of luminescent photobacteria for evaluating the toxicity of 47 MEIC reference chemicals. Effect of salts on luminescence of natural and recombinant luminescent bacterial biosensors. Effect of selected environmental and physico-chemical factors on bacterial cytoplasmic membranes. Effects of rhamnolipids from Pseudomonas aeruginosa DS on luminescent bacteria: Toxicity and modulation of cadmium bioavailability. Generation of thermostable monomeric luciferases from Photorhabdus luminescens. Growth and luminescence of the bacterium Xenorhabdus luminescens from a human wound. Improved detection of toxic chemicals by Photobacterium phosphoreum using modified Boss medium. In vitro toxicity testing using marine luminescent bacteria Photobacterium phosphoreum: In vitro toxicology methods: Impact on regulation from technical and scientific advancements. Luminescent bacteria toxicity assay in the study of mercury speciation. Membrane lipid homeostasis in bacteria. Microbial heavy metal resistance. Molecular biology and utilization for biotechnology process. Molecular biology of bacterial bioluminescence. Optimisation of bioluminescent reporters for use with mycobacteria. Physiological and toxicological characterization of an engineered whole-cell biosensor. Quantitative structure-activity relationships of chemicals acting by non-polar narcosisâ€”theoretical considerations. Reclassification of Vibrio fischeri, Sensitivity and significance of luminescent bacteria in chronic toxicity testing based on growth and bioluminescence. Study of the environmental hazard caused by the oil-shale industry solid waste. The Principles of Humane Experimental Technique; The Salmonella mutagenicity assay: The stethoscope of genetic toxicology for the 21st century. Toxicity evaluation of reactive dyestuff, auxiliaries and selected effluents in textile finishing industry to luminescent bacteria Vibrio fisheri. Correlation with other test systems. Toxicity of cadmium species on luminescent bacteria. Toxicity of metals and metal mixtures: Analysis of concentration and time dependence for zinc and copper. Toxicity testing of 16 priority polycyclic

aromatic hydrocarbons using Lumistox. Use of luminescent bacteria for rapid screening and characterization of short cationic antimicrobial peptides synthesized on cellulose using peptide array technology. Use of the luminescent bacterial system for the rapid assessment of aquatic toxicity.

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3: Correlations of Vibrio fischeri bacteria test data with bioassay data for other organisms. - CORE

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Thus, any damage of cellular metabolism caused by the toxicity of a sample could be monitored by measuring the change of light output of bacteria, the degree of toxicity being proportional to the light loss [4 , 9]. A number of comparisons of the V. Thus, the naturally luminescent bacteria have already proven their potential in toxicity testing. Kinetic format of the V. However, the use of V. Due to that, luciferase encoded from luxCDABE genes from Photorhabdus luminescens has been often used for creation of recombinant luminescent bioreporters [22 â€” 25]. Theoretically, the recombinant bacteria encoding thermostable luxCDABE could be a good alternative broad temperature range, robustness to conventional V. Prior to that, the performance of new recombinant bacteria with thermostable luxCDABE genes should be carefully evaluated in comparison to V. Once validated, this test system could be also relevant for the discovering of group-, genus- or strain-specific antibacterial compounds. Some such systems have been developed and applied for i non-invasive in vivo bioluminescence imaging of virulent Staphylococcus aureus [27], Mycobacterium tuberculosis and M. For the further developing of such kind of models for the toxicity analysis, it is important to be sure that the sensitivity of bacteria to chemicals is attributed to the host bacterium and the test conditions and is not affected by the luminescent system used. The main aim of the current study was to demonstrate that thermostable luxCDABE-transformed constitutively luminescent E. We compared the toxicities of four heavy metals Zn, Cu, Cd, Hg and three organic chemicals aniline, 3,5-dichloroaniline and 3,5-dichlorophenol to two artificially bioluminescent E. All the chosen test chemicals are important environmental toxicants and often used as biocides but differ in their modes of toxic action. To optimize the test conditions, two test media of different composition and complexing potential and exposure times of s, min and min were used. Flash-Assay format of the bioluminescence inhibition assay in the microplate luminometer was used throughout. Materials and Methods 2. Aniline and 3,5-dichloroaniline were purchased from Sigma-Aldrich Steinheim, Germany. The following stock solutions of standard chemicals: Before testing, the stock-solutions were diluted in MilliQ water for E. Escherichia coli Strains Constitutively bioluminescent E. The mid-exponential phase culture was further: As in the toxicity test bacterial suspension is added to equal volume of chemical dilution prepared in water, the final composition of test media for E. Leucine is added due to the auxotrophy of this E. Bacterial suspensions prepared in GAA-M9 were used for toxicity test immediately but bacterial suspensions in Leu-saline were incubated for 1. The number of bacterial cells in the test was determined by counting the number of bacterial colony forming units CFU before the test on agarized LB media supplemented with appropriate antibiotics Table 1. The number of E. The number of V. Bioluminescence Inhibition Toxicity Assay: Testing Procedure The kinetic bioluminescence inhibition assay Flash-Assay was conducted essentially as described in Mortimer et al. The testing with E. For each chemical, 5â€”7 sequential exponential dilutions were analysed. Results of 2â€”3 independent repeats of each experiment performed in different days were used for the calculation of EC50 values see below.

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4: Photobacterium phosphoreum Publications | PubFacts

Each volume in the series focuses on a particular taxon, presenting detailed and reliable ecotoxicological results from both laboratory and field experiments, performed for a comprehensive range of chemicals.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license http: This article has been cited by other articles in PMC. The microplate luminometer and a kinetic Flash-Assay test format was used that differently from Microtox test is also applicable for high throughput analysis. Toxic effects s till min EC50 of four heavy metals Zn, Cd, Hg, Cu and three organic chemicals aniline, 3,5-dichloroaniline and 3,5-dichlorophenol were studied. The most toxic chemical for all used bacterial strains E. Despite of that, toxicity results obtained with both E. The use of amino acids 0. The kinetic Flash Assay test format of the bioluminescence inhibition assay facilitates high throughput analysis. The assay medium, especially in case of testing heavy metals should be a compromise: For initial toxicity screening of chemicals, bacteria are an additional attractive alternative to eukaryotic organisms. The most well-known bacterial in vitro test is Ames assay with Salmonella typhimurium [3], which may predict genotoxic effects of chemicals also to higher organisms e. LuxCDE genes encode a fatty acid reductase complex involved in synthesis of the long chain aliphatic aldehyde RCHO substrate for the luminescence reaction catalyzed by the luciferase LuxAB subunits [8]. Bacterial luciferase enzymes mediate the oxidation of reduced flavin mononucleotide FMNH2 and RCHO by molecular oxygen O2 to produce bioluminescence blue-green light emission with a maximum intensity at about nm. The overall reaction can be summarized as: Thus, any damage of cellular metabolism caused by the toxicity of a sample could be monitored by measuring the change of light output of bacteria, the degree of toxicity being proportional to the light loss [4 , 9]. A number of comparisons of the V. Thus, the naturally luminescent bacteria have already proven their potential in toxicity testing. Kinetic format of the V. However, the use of V. Due to that, luciferase encoded from luxCDABE genes from Photorhabdus luminescens has been often used for creation of recombinant luminescent bioreporters [22 â€” 25]. Theoretically, the recombinant bacteria encoding thermostable luxCDABE could be a good alternative broad temperature range, robustness to conventional V. Prior to that, the performance of new recombinant bacteria with thermostable luxCDABE genes should be carefully evaluated in comparison to V. Once validated, this test system could be also relevant for the discovering of group-, genus- or strain-specific antibacterial compounds. Some such systems have been developed and applied for i non-invasive in vivo bioluminescence imaging of virulent Staphylococcus aureus [27], Mycobacterium tuberculosis and M. For the further developing of such kind of models for the toxicity analysis, it is important to be sure that the sensitivity of bacteria to chemicals is attributed to the host bacterium and the test conditions and is not affected by the luminescent system used. The main aim of the current study was to demonstrate that thermostable luxCDABE-transformed constitutively luminescent E. We compared the toxicities of four heavy metals Zn, Cu, Cd, Hg and three organic chemicals aniline, 3,5-dichloroaniline and 3,5-dichlorophenol to two artificially bioluminescent E. All the chosen test chemicals are important environmental toxicants and often used as biocides but differ in their modes of toxic action. To optimize the test conditions, two test media of different composition and complexing potential and exposure times of s, min and min were used. Flash-Assay format of the bioluminescence inhibition assay in the microplate luminometer was used throughout. Materials and Methods 2. Aniline and 3,5-dichloroaniline were purchased from Sigma-Aldrich Steinheim, Germany. The following stock solutions of standard chemicals: Before testing, the stock-solutions were diluted in MilliQ water for E. Escherichia coli Strains Constitutively bioluminescent E. Recombinant constitutively luminescent Escherichia coli strains used.

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Kaiser Ecotoxicity of chemicals to Photobacterium phosphoreum 2 Handbooks of Ecotoxicological Data 3 Environment Canada. Computox toxicity database (PC version) [CD-ROM]. Burlington, Ontario, CanadarNational Water Research Institute,

Correlations of Vibrio fischeri bacteria test data with bioassay data for other organisms. Significant correlations can be developed for many aquatic species including the fishes fathead minnow, bluegill, catfish, goldfish, goldorfe, guppy, killifish, rainbow trout, sheepshead minnow, and zebrafish; the water flea Daphnia sp. These interspecies relationships can be used to estimate order-of-magnitude type toxic effects of many substances for these aquatic organisms. Highly significant relationships can be obtained when selecting compounds on a chemical basis, such as alcohols, ketones, aromatics, etc. Analogous correlations with mammalian rat and mouse oral, intraperitoneal, and intravenous median lethal dose LD50 data are much weaker than those for most aquatic species. However, there are significant differences between these three routes of administration and the intravenous LD50 data show the best relationship with the Vibrio data Topics: Research Article Provided by: Sorry, we are unable to provide the full text but you may find it at the following location s: Suggested articles Citations A comparison ofthree microbial assay procedures for measuring toxicity ofchemical residues. Arch Environ Contam Toxicol Acute toxicity tests using rotifers. Effects of temperature, strain and Environmental Health Perspectives - Aquatic toxicological aspects ofdithiocarbamates and related compounds. Aquatic toxicology of alkyl-quinolines. Battery of screening tests approach applied to sediment extracts. Combination ofsingle-species laboratory tests for the assessment ofthe ecotoxicity ofp-benzoquinone. Comparaison des sensibilites du test de luminescence bacterienne Photobacteriumphosphoreum et du test Daphnie Daphnia magna pour 14 substances a risque toxique eleve. Comparative evaluation ofthree rapid marine toxicity tests: Environ Toxicol Chem Comparative toxicology oflaboratory organisms for assessing hazardous waste sites. Comparison ofa luminescent bacterial test with other bioassays for determining toxicity of pure compounds and complex effluents. Aquatic Toxicology and Hazard Assessment: Comparison ofthe Microtox test with the hr LC50 test for the harpacticoid Nitocraspinipes. Ecotoxicol Environ Saf Comparisons between bioassays and alterations ofbenthic macroinvertebrate assemblages at a marine superfund site, Computox toxicity database PC version Ecotoxicity of chemicals to Photobacterium phosphoreum. Ecotoxicological assessment of Tebuthiuron, a substituted urea class herbicide. Effects ofselected chemicals to photoluminescent bacteria and their correlations with acute and sublethal effects on other organisms. Evaluation of sucrose as an alternative to sodium chloride in the Microtox assay: Environ Toxicol Chem Evaluation ofa bacterial bioassay as a method for predicting acute toxicity oforganic chemicals to fish. Evaluation ofa new approach to the safety assessment ofbiomaterials. Drug Chem Toxicol Feed forward backpropagation neural networks and their use in predicting the acute toxicity ofchemicals to the fathead minnow. Inhibition ofbioluminescence in a recombinant Escherichia coli. Interactions between copper and some carbamates used in phytosanitary treatments. Interspecies toxicity correlations of rat, mouse and Photobacterium phosphoreum. Photobacteriumphosphoreum toxicity data index. Qualitative and quantitative relationships of Microtox data with toxicity data for other aquatic species. Relationship between toxicity oforganic chemicals to fish and to Photobacterium phosphoreum. American Society for Testing and Materials, The acute toxicity of pulse-dosedpara-substituted phenols to larvalAmerican flagfish Jordanellafloridae: Sci Total Environ The luminescent bacteria toxicity test, its potential as an in-vitro alternative. The Microtox as an alternative assay in the acute toxicity assessment ofwater pollutants. The Microtox toxicity test, a developers commentary. The relative sensitivity of Microtox, daphnid, rainbow trout, and fathead minnow acute lethality tests. The role of Microtox in the detection and control of toxic trade effluents and spillages. Toxicities of chloroanilines to Photobacteriumphosphoreum and their correlations with effects on other organisms and structural parameters.

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Toxicities oflead, cadmium and mercury to microbes Saccharomyces cerevisiae, Pseudomonasfluorescens, Escherichia coli and Photobacterium phosphoreum [Abstract]. Toxicity of methylenebisthiocyanate MBT to several freshwater organisms. Toxicity oforganophosphate insecticides and their metabolites to the water flea, Daphnia magna, the Microtox test and an acetylcholinesterase inhibition test.

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6: Kaiser, Klaus L. E. [WorldCat Identities]

Ecotoxicity of chemicals to Photobacterium phosphoreum K.L.E Kaiser, J Devillers (Eds.), Handbooks of Ecotoxicological Data, 2, Gordon and Breach Science Publishers () Environmental Canada,

The first part, I. It includes a list of relevant references and tables showingcompari- sons of Microtox test results with those of various other acute toxicity assays for selected compounds and complex industrial effluents. The second part of this review deals with toxicity data compilation. With the number of man-made chemicals approaching four million and constantly increasing, toxicity assessment of single chemical compounds and of complex industrial effluents has be- come an increasingly difficult task. The determination of the acute, sublethal, and chronic toxic- ity of any single compound is generally very expensive and time-consuming. Moreover, the study of potential synergistic or antago- nistic effects of a multitude of toxic substances present in many effluents becomes virtually an impossible task. Conventional aquatic acute toxicity tests with common fish such as rainbow trout, guppy, flagfish, zebrafish, etc. Therefore, there is an urgent need Toxicity Assessment: An International Quarterly Vol. As different organisms react differently to any toxic substance, any assurance for the safety or nontoxicity of a chemical compound or a complex wastewater effluent requires a variety of bioassays in- volving organisms from different levels of biological organization. Economic factors, however, limit the type and number of tests that can be undertaken. In a recent study on ecotoxicological assess- ment, Blaise et al. This distinction can be accomplished by using a battery of tests which include several representative aquatic species such as bacteria, algae, invertebrates, and fish, to assess with accuracy the hazard that an effluent or a toxic chemi- cal may present to the aquatic environment. Mathematical models, using techniques known as Quantita- tive Structure-Activity Relationships, have been used for the pre- diction of the magnitudes of a variety of biological effects of chemi- cal substances to many living organisms. With their help, the biological activity and biochemical pathways of many chemicals have been predicted on the basis of their structural properties. Moreover, such relationships have become important tools in the development of more effective and specific drugs, pesticides, and herbicides Purcell et al. The prediction of the toxicity of aquatic contaminants using similar techniques Koch, is somehow more complicated since such effects are usually the result of several biochemical reactions. The current research on structure-toxicity relationships as a viable technique for the prediction of the toxicity of chemical substances to the aquatic environment, has been the main subject of international conferences and workshops. An important aspect of these investigations is the evaluation of some current toxicity tests and their usefulness for the generation of sufficient toxicity data with relatively inexpensive and quick bioassays that give accurate and precise results. This need for fast, sensitive tests for aquatic toxicity assessment is even more pronounced in the contin- uous monitoring of industrial effluents and wastewater treatment systems. Microbial tests, due to several factors, such as similarity of complex biochemical functions with higher organisms, ease of handling, short exposure time, and reproducibility of the results between laboratories, have been widely used in toxicity screening procedures. Enzymatic activity, growth inhibition, reproduc- tion rate, oxygen demand, metabolic light and heat release, have been measured as parameters to assess the toxic effects of indus- trial wastes and single contaminants. This bacterial bioassay is based on the reduction of light emitted by a nonpathogenic strain of luminescent marine bac- terium upon exposure to a toxic sample. In fact, several species of light emitting bacteria have been tested and proposed as biological systems suitable for toxicity testing Shiotsuka et al. These organisms emit light under normal life conditions, as a consequence of the series of metabolic reactions which liberate energy in the form of visible light. On exposure to toxic substances, the light output is reduced and this reduction is proportional to the toxicity of the sample. Therefore, a toxicity bioassay may be based on the light emission of these bacteria, as a measurement of their metabolic activity. Several strains of luminescent bacteria and culture media were studied and evaluated and a specific test for the rapid assessment of the toxicity of aquatic samples using the light emitting bacte- rium Photobacteriumphosphoreum was

proposed by Bulich Bulich and coworkers also developed a lyophilization procedure to standardize the bacterial culture and presented results on the precision, accuracy and sensitivity of the method, and the effect of pH, temperature, exposure time, and sample concentration on the response of the test organisms. Although the mechanism of light emission and its interaction with toxic sub- stances are only partially understood, the bacterial luminescence bioassay shows great promise as it responds to a wide range of compounds. Experimental Details The Photobacterium phophoreum light emission spectrum spans from to nm with an intensity maximum at nm, there- fore in the visible region of the spectrum. Intensity of the light output depends on several external factors including temperature, pH7 salinity, nature and concentration of the toxicant, etc. Photobacterium phosphoreum is a marine bacterium natu- rally adapted to a saline environment and the NaCl concentration of the test solution affects the intensity of the emitted light. The pH range for the optimal physiological conditions of this bacterium is between 5 and 9. The intensity of the emitted light does not change significantly within these limits, but decreases dramatically outside this range. A pH range of 6. The adjustment of the pH of the sample is not only important to maintain proper physiological conditions for the test organisms, but even more so because of the changes in the chemical nature, hence toxicity of many substances. The level of ionization will depend on the pH of the test solution. For the determination of the toxicity of pure, ioniz- able compounds, the pH has to be adjusted within the wider range of pH 5 to 9 to produce essentially only one of the chemical forms. However, for complex effluents the toxicity would have to be mea- sured at the actual pH at the point of discharge, to closely simulate the natural conditions. Shorter exposure times are required to get similar response at higher temperatures. Good commercial analyzers can regulate the test temperature to within 0. The test temperature selection is usually an arbitrary com- promise between light output, strength of response, and a low rate of decay of the light emission during the test. Sensitivity of Bacteria The light intensity changes with both age of the bacteria and exposure time. A temperature equilibration period of about 15 min is recommended, after this time the drift in the light intensity is minimal and is generally lower in aged reconstituted bacterial solutions compared to freshly prepared suspensions. To correct for this natural decay, a blank reading is recorded at each time of recording. After a variable time period usually hr, depending on the general "health" characteristics of the bacteria , the light inten- sity becomes too low to be reproducibly recorded by the instrument and the bacteria are no longer useful. In our experience, this time is quite variable, and depends on the bacteria culture itself, the shipping and storage conditions, and on the reconsitution process of the freeze-dried organisms. The relationship between the exposure-time and bacteria re- sponse is significantly dependent on the nature of the specific compound tested. Furthermore, the absolute concentration of the toxi- cant is also an important variable. For these reasons short expo- sure times 5 or 15 min can give rise to incorrect results for some compounds. However, there is no significant difference between 5 and 30 min EC values for most chemicals. This number of organisms greatly exceeds that of most other bioassays. Obviously, the measured light intensity depends also on the number of organisms. However, even though the actual readings of the emitted light intensity are proportional to the number of organisms present, i t has no detectable effect on the final ECS0 value calculated when applying the data reduction procedure below. In this luminescent, bacterial bioassay, each test involves approximately lo6 individuals and the determined response is a measure of the integrated effect of the toxicant on the entire population. As the total light output of any bacterial suspension de- creases with time, ECS0 values are time dependent and the data reduction protocol has to account for the natural decay of the bacterial light output. For practical purposes, it has been proposed and widely ac- cepted to use the GAMMA function as the bioassay response pa- rameter. It is determined for each of the normally four different sample concentrations at each of the selected expo- sure times. The r function is calculated according to the data reduction scheme shown. Blank readings at times 0 and t I[cl0, I[c],: Readings of light intensity for a cuvette containing toxic sample solution a t concentration [c] at times 0 and t When plotting the log r values so calculated against the loga- rithm of the corresponding concentrations, ideally straight lines are observed. Practically, due to errors inherent to the experimen- tal procedure, variations occur which require statistical

analysis, such as least squares regression fit, or graphical resolution, such as probit analysis. From the normal experiment, where one blank and four seri- ally diluted toxicant concentrations are tested and their light output is measured at each of the 0,5 ,15 , and 30 min intervals, the number of calculations involved take approximately 30 min for a skilled operator, even with the help of a small hand-held calcula- tor. A num- ber of publications discuss these aspects. Bulich and coworkers Bulich, ; Bulich and Isenberg, ; Bulich et al. The bioassay compares favourably with other tests in sensitivity, and good cor- relation with other bioassays has been found for several classes of common contaminants. The reproducibility of the test was also evaluated. The Microtox test has been compared with other microbial tests. The response of light emitting bacteria to common toxicants has been compared to the response obtained using nonluminescent bacteria such as Spirillum uolutans, Pseudomonas fluorescens, Aeromonas hydrophila Dutka and Kwan, , , Bacillus subtilis, and Bacillus sp. Ribo and Kaiser, Comparisons of the Microtox toxicity with inhibition of respiratory activity of activated sludge, and inhibition of activated sludge TTC dehydro- genase activity have also been reported Dutka et al. Some problems in reproducibility of the values and inconsistency of results from different laboratories have al- ready been mentioned. However, these problems are common in fish and other bioassays as well. Moreover, direct relationships were found between both tests, even when the prediction of fish LCs0 values from Microtox results has to be taken as a toxicity estimate, to be reliable only within an order of magnitude. Comparison of the response of the test for a set of 15 chemical contaminants and its use as a prescreening tool for aqua- t ic pollutants was reported by DeZwart and Sloof Another evaluation of the Microtox toxicity bioassay and com- parison with a two-organism test for the detection of aquatic toxic- ity was described by McFeters et al. These authors com- pared the toxic activity of 35 test chemicals as measured by fish bioassays and the Microtox test, and the combined toxic effect of a bioluminescent bacteria and an alga in concert, known as the two-organism procedure of Tchan et al. The Microtox test proved to be somewhat more sensitive for most of the test chemi- cals than the Tchan procedure, while the fish bioassays were more sensitive than both microbial tests Chang et al. However, photosynthesis-inhibiting herbicides were detected at lower con- centrations by the Tchan procedure than by either of the other two bioassays. The applicability of the Microtox test to monitoring industrial wastewaters has been evaluated by several authors. A comparison between the use of fish bioassay and Microtox for the assessment of the toxic effects of oil-production wastewaters Table V has also been reported by Lebsack et al. The use of this test as an environmental monitoring assay was further evaluated by other investigators Chang et al. Finally, Y ates and Porter , have reported on the use of the Microtox test as a bioassay for mycotoxins and found dependence of this test on the pH and temperature of the sample. Recently, Mantel et al. They compared the effect of different types of radiation on the luminescent bacteria and the applicability of this test as a biological radiation dosimeter. SS - Slight stimulation. NL - Non lethal. In another area of research, an in-depth study by Krebs describes the physiology of these luminescent bacteria and the dependence of the tests results on variables such as pH, tempera- ture, sample concentration, population of bacteria in the test solu- tion, and age of the culture. Included was a detailed description of the emission spectrum, and the influence of the saline concentra- tion on the response of the bacteria. Several com- munications deal with the use of the Microtox test for the toxicity assessment of single chemicals and industrial wastewaters. The Microtox test was considered to be a useful tool for prescreening aquatic pollutants and toxic wastewaters by providing quick and reliable toxicity data. Linear relationships are encountered for semi- homologous series of chemical contaminants when the Microtox test results were compared with other toxicity values Ribo and Kaiser In addition, the test provided an economical source of toxicity data otherwise not available from conventional fish tests Indorato et al. The Microtox toxicity of chlorinated aromatic compounds such as phenols, anilines, pyridines, benzenes, and nitrobenzenes Table VI has been explained on the basis of physico-chemical properties of these compounds, primarily the octanollwater parti- tion coefficient, and other structural properties including the Van der Waals volume, molecular symmetry, hydrophilic effect, etc. Kaiser and Ribo, Recently, Microtox toxicity ofpara-chloro- substituted benzenes has been determined, and some structure- toxicity relationships have been

developed Figure 1 , evaluating the possibility of prediction of aquatic toxicity of these compounds from physico-chemical data using a mathematical equation Kai- ser et al. The use of the Microtox test for surveying surface waters has been the subject of another recent investigation Ribo et al. On the basis of these data, more detailed sampling and analysis was recommended to accu- rately determine the sources and extent of aquatic contamination.

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