DOWNLOAD PDF CHEMICAL WARFARE AGENT THREAT TO DRINKING WATER HARRY SALEM . [ET AL.]

Chapter 1 : Chemical weapons in World War I - Wikipedia

Chapter 3 Chemical Warfare Agent Threat to Drinking Water.. 51 Harry Salem, Christopher E. Whalley, Charles H. Wick, Thomas P. Gargan II, and W. Dickinson Burrows.

Biochemistry[edit] Ricin is classified as a type 2 ribosome-inactivating protein RIP. Whereas type 1 RIPs are composed of a single protein chain that possesses catalytic activity, type 2 RIPs, also known as holotoxins, are composed of two different protein chains that form a heterodimeric complex. Type 2 RIPs consist of an A chain that is functionally equivalent to a type 1 RIP, covalently connected by a single disulfide bond to a B chain that is catalytically inactive, but serves to mediate transport of the A-B protein complex from the cell surface, via vesicle carriers, to the lumen of the endoplasmic reticulum ER. Both type 1 and type 2 RIPs are functionally active against ribosomes in vitro; however, only type 2 RIPs display cytotoxicity due to the lectin -like properties of the B chain. In order to display its ribosome-inactivating function, the ricin disulfide bond must be reductively cleaved. Within the lumen of the ER the propolypeptide is glycosylated and a protein disulfide isomerase catalyzes disulfide bond formation between cysteines and The propolypeptide is further glycosylated within the Golgi apparatus and transported to protein storage bodies. The propolypeptide is cleaved within protein bodies by an endopeptidase to produce the mature ricin protein that is composed of a residue A chain and a residue B chain that are covalently linked by a single disulfide bond. Ricin toxin B chain RTB is a lectin composed of amino acids that is able to bind terminal galactose residues on cell surfaces. At least one of these three subdomains in each homologous lobe possesses a sugar-binding pocket that gives RTB its functional character. While other plants contain the protein chains found in ricin, both protein chains must be present in order to produce toxic effects. For example, plants that contain only protein chain A, such as barley , are not toxic because without the link to protein chain B, protein chain A cannot enter the cell and do damage to ribosomes. In addition, the mannose -type glycans of ricin are able to bind to cells that express mannose receptors. The holotoxin can be taken up by clathrin -coated pits, as well as by clathrin-independent pathways including caveolae and macropinocytosis. The active acidification of endosomes is thought to have little effect on the functional properties of ricin. Because ricin is stable over a wide pH range, degradation in endosomes or lysosomes offers little or no protection against ricin. This process is catalysed by the protein PDI protein disulphide isomerase that resides in the lumen of the ER. ERAD normally removes misfolded ER proteins to the cytosol for their destruction by cytosolic proteasomes. Dislocation of RTA requires ER membrane-integral E3 ubiquitin ligase complexes, [23] but RTA avoids the ubiquitination that usually occurs with ERAD substrates because of its low content of lysine residues, which are the usual attachment sites for ubiquitin. In the mammalian cell cytosol, RTA then undergoes triage by the cytosolic molecular chaperones Hsc70 and Hsp90 and their co-chaperones, as well as by one subunit RPT5 of the proteasome itself, that results in its folding to a catalytic conformation, [20] [25] which de-purinates ribosomes , thus halting protein synthesis. A single RTA molecule in the cytosol is capable of depurinating approximately ribosomes per minute. Depurination reaction[edit] Within the active site of RTA, there exist several invariant amino acid residues involved in the depurination of ribosomal RNA. In particular, Arg and Glu have been shown to be involved in the catalytic mechanism, and not substrate binding, with enzyme kinetic studies involving RTA mutants. The model proposed by Mozingo and Robertus, [8] based on X-ray structures, is as follows: Sarcin-ricin loop substrate binds RTA active site with target adenine stacking against tyr80 and tyr Bond cleavage results in an oxycarbonium ion on the ribose, stabilized by Glu N-3 protonation of adenine by Arg allows deprotonation of a nearby water molecule. Resulting hydroxyl attacks ribose carbonium ion. Depurination of adenine results in a neutral ribose on an intact phosphodiester RNA backbone. Toxicity[edit] Castor beans Ricin is very toxic if inhaled , injected , or ingested. It can also be toxic if dust contacts the eyes or if it is absorbed through damaged skin. It acts as a toxin by inhibiting protein synthesis. Ricin is resistant, but not impervious, to digestion by peptidases. By ingestion, the pathology of ricin is largely restricted to the gastrointestinal tract, where it may cause mucosal injuries. With appropriate treatment, most patients will make a decent recovery. When ingested, gastrointestinal symptoms can manifest within 6 hours; these symptoms do not always become apparent. Within 2 to 5 days of exposure to ricin, effects of ricin on the central nervous system , adrenal glands , kidneys , and liver appear. Gastrointestinal symptoms quickly progress to severe nausea, vomiting, diarrhea, and difficulty swallowing dysphagia. Haemorrhage causes bloody feces melena and vomiting blood hematemesis. The low blood volume hypovolemia caused by gastrointestinal fluid loss can lead to organ failure in the pancreas, kidney, liver, and GI tract and progress to shock. Shock and organ failure are indicated by disorientation, stupor, weakness, drowsiness, excessive thirst polydipsia , low urine production oliguria , and bloody urine hematuria. Early symptoms include a cough and fever. This is indicated by edema of the eyes and lips; asthma ; bronchial irritation; dry, sore throat; congestion; skin redness erythema ; skin blisters vesication ; wheezing ; itchy, watery eyes; chest tightness; and skin irritation. Existing treatments emphasize minimizing the effects of the poison. Possible treatments include intravenous fluids or electrolytes, airway management , assisted ventilation , or giving medications to remedy seizures and low blood pressure. If the ricin has been ingested recently, the stomach can be flushed by ingesting activated charcoal or by performing gastric lavage. Survivors often develop long-term organ damage. Ricin causes severe diarrhea and vomiting, and victims can die of circulatory shock or organ failure; inhaled ricin can cause fatal pulmonary edema or respiratory failure. Death typically occurs within 3â€”5 days of exposure. When a ricin-laced pellet was removed from the small of his back it was found that some of the original wax coating was still attached. For this reason only small amounts of ricin had leaked out of the pellet, producing some symptoms but allowing his body to develop immunity to further poisoning. As ricin is not oil-soluble, little is found in the extracted castor oil. However, swallowing castor beans rarely proves to be fatal unless the bean is thoroughly chewed. The laboratory testing usually involves immunoassay or liquid chromatography-mass spectrometry. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. March Learn how and when to remove this template message Although no approved therapeutics are currently based on ricin, it does have the potential to be used in the treatment of tumors , as a "magic bullet" to destroy targeted cells. The major problem with ricin is that its native internalization sequences are distributed throughout the protein. If any of these native internalization sequences are present in a therapeutic agent, the drug will be internalized by, and kill, untargeted non-tumorous cells as well as targeted cancerous cells. Modifying ricin may sufficiently lessen the likelihood that the ricin component of these immunotoxins will cause the wrong cells to internalize it, while still retaining its cell-killing activity when it is internalized by the targeted cells. However, bacterial toxins, such as diphtheria toxin , which is used in denileukin diftitox , an FDA-approved treatment for leukemia and lymphoma, have proven to be more practical. A promising approach for ricin is to use the non-toxic B subunit a lectin as a vehicle for delivering antigens into cells, thus greatly increasing their immunogenicity. Use of ricin as an adjuvant has potential implications for developing mucosal vaccines. Regulation[edit] In the U. Ricin was given the military symbol W or later WA. Army Chemical Corps began a program to weaponize sarin. The Soviet Union also possessed weaponized ricin. There were speculations that the KGB used it outside the Soviet bloc; however, this was never proven. The castor bean plant from which ricin is derived is a common ornamental and can be grown at home without any special care. Under both the Biological Weapons Convention and the Chemical Weapons Convention , ricin is listed as a schedule 1 controlled substance. Compared to botulinum or anthrax as biological weapons or chemical weapons , the quantity of ricin required to achieve LD50 over a large geographic area is significantly more than an agent such as anthrax tons of ricin vs. The vaccine is safe and immunogenic in mice, rabbits, and humans. It has completed two successful clinical trials. Incidents involving ricin Ricin has been involved in a number of incidents. In , the Bulgarian dissident Georgi Markov was assassinated by Bulgarian secret police who surreptitiously shot him on a London street with a modified umbrella using compressed gas to fire a tiny pellet contaminated with ricin into his leg. The prime suspects were the Bulgarian secret police: Georgi Markov had defected from Bulgaria some years previously and had subsequently written books and made radio broadcasts that were highly critical of the Bulgarian communist regime. However, it was believed at the time that Bulgaria would not have been able to produce the pellet, and it was also believed that the KGB had supplied it. Earlier, Soviet dissident Aleksandr Solzhenitsyn also suffered but survived ricin-like symptoms after an encounter in with KGB agents. Kostov was standing on an escalator of the Paris metro when he felt a sting in his lower back above the belt of his trousers. He developed a fever, but recovered. A letter containing ricin was also alleged to have been sent to American President Barack Obama at the same time. An actress, Shannon Richardson , was later charged with the crime, to which she pleaded guilty that December. Kuntal Patel from London attempted to poison her "controlling and selfish" mother with abrin after the latter interfered with her marriage plans.

Chapter 2 : Water Treatability Database | US EPA

Chemical Warfare Agents provides first responders and emergency medical teams with the most up-to-date information they need to prepare for and handle natural disasters, chemical spills, terrorism, and warfare situationsâ€"quickly and effectively.

The first physical cleanup action underway at a site, consisting of either a removal or remedial activity. Potentially responsible party reimbursement of Superfund expenditures in direct response to EPA demand letters. Administrative Order on Consent: The Superfund Amendment and Reauthorization Act SARA requires that administrative records be compiled at Superfund sites where remedial or removal responses are planned, or are occurring, or where EPA is issuing a unilateral order or initiating litigation to track enforcement case budget funds used for any activity being led by a Responsible Party. These advisory boards involve regulators and the public participating in key federal facility cleanup decisions for specific installations. The aerial survey support provides four types of remote sensing projects: Alternate name under which a site may be identified. A procedure that is used to prevent and resolve disputes with external parties by the use of a neutral third party mediator that has no stake in the outcome of the process. The Archive designation indicates the site has no further interest under the Federal Superfund Program based on available information. Top of Page C City: The name of the city, town, village, or other municipality where a site is located or an incident occurs, or the nearest geographical place name if a site or incident is not located within a formal jurisdiction. Claim in Bankruptcy Proceeding: Cleanup activities at a site include removals, studies, remedy selection, remedy design, remedy implementation, and post-construction activities. The completion of each activity enables the site to move further along in the cleanup process. Post-Construction - Superfund Post-Construction is a cleanup phase where several activities are generally undertaken at sites following the construction of response actions. These activities include operation and maintenance and long-term response actions; five-year reviews, close-out reports, and deletion from the NPL. The goal of Superfund Post-Construction is to ensure that response actions provide for the long-term protection of human health and the environment. Remedy Construction - Remedy Construction is the phase in Superfund site cleanup where the actual remedy e. Remedy Design - Remedy Design RD is the phase in Superfund site cleanup where the technical specifications for cleanup remedies and technologies are designed. Remedy Selected - The remedy selected at a site is the method that EPA has determined will best address, correct, or remediate the contamination concerns at the site. The ROD provides the justification for the remedial action treatment chosen in the Record of Decision. It also contains site history, site description, site characteristics, community participation, enforcement activities, past and present activities, contaminated media, the contaminants present, scope and role of response action, and the remedy selected for cleanup. Removal - A removal is a short-term cleanup intended to stabilize or clean up a site that poses an imminent and substantial threat to human health or the environment. Removals can occur at any stage of the Superfund cleanup process, but are often the first response upon discovery of a hazardous substance at a site. Study - A number of studies are undertaken at a site to determine site conditions, the nature and extent of contamination, the criteria that will be required to clean up the site, preliminary alternatives for cleanup actions, and technical and cost analyses of the alternatives. The two most common studies are called the Remedial Investigation and Feasibility Study. A report submitted by the remedial program manager RPM verifying that the conditions of the site comply with the Record of Decision ROD findings and design specifications, cleanup standards have been met, and activities performed at the site are sufficient to achieve protection of public health and the environment. Completion of a preliminary assessment PA and site investigation SI together in order to reduce repetitive tasks and costs that might occur when these activities are conducted separately. The process of data collection and analyses of the site problem, identification of preliminary remedial alternatives, and recommendation of a cost-effective remedy. EPA sends a letter to parties that provides information regarding the potential for EPA action at the property. A Superfund Community Advisory Group CAG is a committee, task force or board made up of residents of a community with Superfund or other environmental problems. The Community Advisory Group enhances public participation in the cleanup process and other environmental decision-making by providing a public forum where community representatives can discuss their diverse interests, needs and concerns. The community relations activities, i. The official date a removal or response action has been completed at a site. Such cases typically cite but are not limited to violation of Section notification requirements. Administrative agreement used to initiate potentially responsible party PRP response or cost recovery. This agreement may settle litigation or may be presented concurrently with the complaint achieved through negotiations. The agreement may be for response work, cost recovery, or both. Remedies at a site often require physical construction e. A site is categorized as Construction Completion by meeting one of the following criteria: Contaminants of Concern COC: The Contaminated Groundwater Migration GM environmental indicator documents whether contamination is below protective, risk-based levels or, if not, whether the migration of contaminated groundwater is stabilized and there is no unacceptable discharge to surface water and monitoring will be conducted to confirm that affected groundwater remains in the original area of contamination. This indicator normally is limited to sites with known groundwater contamination. A conclusion of "migration of contaminated groundwater under control" generally indicates that all information on known and reasonably expected groundwater contamination has been reviewed and the above conditions are met. Medium affected by contaminants at a site. Types of media include: The name of the county in which a site is located or an incident occurs. Deletion of sites from the National Priorities List NPL may occur once all response actions are complete and all cleanup goals have been achieved. EPA has the responsibility for processing deletions with concurrence from the State. EPA can also delete portions of sites that meet deletion criteria. Deletion from National Priorities List: The process by which a potential hazardous waste site is brought to the attention of the EPA. The process can occur through the use of several mechanisms such as a phone call or referral by another government agency. Ecological risk assessments evaluate the possibility that adverse ecological effects are occurring or may occur as a result of exposure to physical e. These assessments often contain detailed information regarding the interaction of these factors with the biological community at the site. Eligible Response Site ERS Exclusion indicates that the Region has made a decision to exclude a site from the universe of sites eligible for Brownfields response. Study to identify the objectives of a removal action and to analyze the cost effectiveness and implement ability of the various alternatives that may be used to satisfy these objectives. An environmental analysis prepared pursuant to the National Environmental Policy Act to determine whether a federal action would significantly affect the environment and thus require a more detailed environmental impact statement. A document required of federal agencies by the National Environmental Policy Act for major projects or legislative proposals significantly affecting the environment. A tool for decision making, it describes the positive and negative effects of the undertaking and cites alternative actions. An identifier unique to the Superfund program for a site or facility. The first two characters are equal to the state code of the state where a site is located. Provides financial resources to state and local authorities involved in evacuation activities at hazardous waste sites. Additional study undertaken if it is determined that data collected in the site inspection is not sufficient. The present site inspection focus on pathways and receptors has been expanded to include site and source characterization. An assessment that characterizes the magnitude and severity of hazardous waste sites. Explanation of Significant Differences: A document outlining minor changes in the original remedy selected at a site as described in the Record of Decision ROD , such as a contingent remedy. Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term acute exposure , of intermediate duration, or long-term chronic exposure. The way in which a person, species, or environment comes into contact with contamination. Types of Exposure Pathways include soil, air, groundwater, and surface water. Top of Page F Feasibility Study: A study of a hazardous waste site intended to: In addition, Other Cleanup Activity sites may be deemed stalled if the entity overseeing the post-assessment activities reported to EPA that the site is out of compliance with the applicable regulatory program or is otherwise considered by the oversight entity to have made unsatisfactory progress. Undetermined Documentation - EPA is in the process of obtaining information documenting the most recent activity from the State or Federal Agency responsible for the site; or is in the process of reaching a determination on the most updated documents received. All site-specific oversight associated with a federal facility FF response action. Federal Facility Community Involvement: At a federal facility site, the community relations activities, i. Federal Facility Feasibility Study: Study of a hazardous waste site conducted by a federal facility to 1 evaluate alternative remedial actions from technical, environmental, and cost effectiveness perspectives 2 recommend the cost-effective remedial action 3 prepare a conceptual design 4 prepare a cost estimate for budgetary purposes and 5 prepare a preliminary construction schedule. Federal Facility Five-Year Review: At a federal facility, five-year reviews generally are required by CERCLA or program policy when hazardous substances remain on site above levels which permit unrestricted use and unlimited exposure. Five-year reviews provide an opportunity to evaluate the implementation and performance of a remedy to determine whether it remains protective of human health and the environment. Generally, reviews are performed five years following the initiation of a CERCLA response action, and are repeated every succeeding five years so long as future uses remain restricted. Five-year reviews can be performed by EPA or the lead agency for a site, but EPA retains responsibility for determining the protectiveness of the remedy. Federal Facility Preliminary Assessment Review: Quality assurance review of a preliminary assessment PA report submitted by another federal agency. Federal Facility Remedial Action: An FF RA is the actual construction or implementation phase of a Superfund site cleanup that follows remedial design and is conducted by a federal facility. Federal Facility Remedial Design: FF Remedy Design RD is the phase in Superfund site cleanup where the technical specifications for cleanup remedies and technologies are designed by a federal facility. Federal Facility Remedial Investigation: An investigation conducted by a federal facility that gathers data necessary to 1 determine the nature and extent of problems at the site 2 establish cleanup criteria for the site 3 identify preliminary alternative remedial actions and 4 support the technical and cost analyses of the alternatives. The process of data collection and analyses of the site problem, identification of preliminary remedial alternatives, and recommendation of a cost-effective remedy by a federal facility. A FF removal is a short-term cleanup conducted by the federal facility and is intended to stabilize or clean up a site that poses an imminent and substantial threat to human health or the environment. Federal Facility Site Inspection Review: Quality assurance review of a site inspection SI report submitted by another federal agency. Final Listing on National Priorities List:

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Chapter 3 : Chemical warfare agents

Chemical warfare agent threat to drinking water / Harry Salem [et al.] Health effects of low-level exposure to nerve agents / John H. McDonough and James A. Romano Jr.

Find articles by K. Raza Find articles by S. Vijayaraghavan Find articles by R. This article has been cited by other articles in PMC. Abstract Among the Weapons of Mass Destruction, chemical warfare CW is probably one of the most brutal created by mankind in comparison with biological and nuclear warfare. Chemical weapons are inexpensive and are relatively easy to produce, even by small terrorist groups, to create mass casualties with small quantities. The characteristics of various CW agents, general information relevant to current physical as well as medical protection methods, detection equipment available and decontamination techniques are discussed in this review article. A brief note on Chemical Weapons Convention is also provided. Blister agents, chemical warfare, decontamination, detection, mustards, nerve agents, protection Among the Weapons of Mass Destruction WMD , chemical warfare CW is probably one of the most brutal created by mankind. CW agents are extremely toxic synthetic chemicals that can be dispersed as a gas, liquid or aerosol or as agents adsorbed to particles to become a powder. These CW agents have either lethal or incapacitating effects on humans. Thousands of toxic substances are known, but only some of them are considered as CW agents based on their characteristics, viz. The use of poisonous chemicals from plant extracts to poison individuals is widely documented throughout the Middle Ages and Renaissance, but it was not until the expansion of industrial chemistry in the 19th century that mass production and deployment of CW agents in war became a possibility. Thus, the birth of modern CW was ushered in by the German gas attack with chlorine on 22nd April at Ypres, Belgium. The use of these toxic chemicals, including phosgene, sulfur mustard and lewisites caused , deaths and 1. The largest single CW attack killing around 5, people followed an Iraqi nerve agent attack on the Kurdish civilian population of Halabja. This attack illustrates the one single characteristic of CW agents that allows them to be considered as WMD. This has been made particularly evident by the Sarin attacks by a Japanese cult in Matsumoto city and the Tokyo subway system , causing 5, injuries and 12 deaths. The threat of using CW agents in domestic terrorist attack was demonstrated for the first time in these cases. However, mass casualties were prevented not as a consequence of the medical response but because of the inefficiency of the delivery method. Terrorists have previously used more conventional means of violence, such as bombings, assassinations and hostage taking, to promote their causes. Terrorism and criminal activities achieved a whole new quality after incidents like the repeated assaults on the World Trade Center in New York culminating in its destruction on September 11, and the subsequent dissemination of anthrax-letters. The major reasons for the production and use of such weapons are manifold. First, chemical weapons are cost-effective, particularly when used against concentrated forces or populations. Second, they may be used at lower levels of concentration with an aim to cause panic and disorder among civilians. Among the CW agents, chlorine, phosgene and cyanides are widely used in the manufacturing processes of various chemical or pharmaceutical industries. Thus, the act of terrorism might also occur in the form of a toxic chemical release, e. The effect of intentional release of CW agent varies greatly, depending on several factors, including the toxicity of the compound, its volatility and concentration, the route of exposure, the duration of the exposure and the environmental conditions. The release of such agents in an enclosed place could deliver doses high enough to injure or kill a large number of people, whereas in an open area, chemical cloud would become less concentrated as it spreads, leading possibly to numerous mild casualties. In the present time, all over the world, chemical terrorism is a serious threat to the security of mankind, whose scale essentially exceeds the impact of use of the most modem firearms. The role of the CWC is also briefly mentioned. Classification of CW Agents The CW agents possess different characteristics and belong to various classes of compounds with pronounced physicochemical, physiological and chemical properties. Based on their volatility, they are classified as persistent or non-persistent agents. The more volatile an agent, the quicker it evaporates and disperses. The more volatile agents like chlorine, phosgene and hydrogen cyanide are non-persistent agents whereas the less volatile agents like sulfur mustard and Vx are persistent agents. Based on their chemical structure, they can be classified as organophosphorus OP , organosulfur and organofluorine compounds and arsenicals. In general, classification in terms of physiological effects produced on humans by the CW agents is used for many decades. Thus, the CW agents used in warfare are classified as follows:

Chapter 4 : National Environmental Monitoring Conference - NEMC

Brief history and use of chemical warfare agents in warfare and terrorism / Harry Salem, Andrew L. Ternay Jr., and Jeffery K. Smart --Chemistry of chemical warfare agents / Peter Kikilo, Vitaly Fedorenko, and Andrew L. Ternay Jr. --Chemical warfare agent threat to drinking water / Harry Salem [and others] --Health effects of low-level exposure.

The German scientist had proposed using chlorine gas on Allied troops, overseen its development as a weapon, and gone to the front lines himself to supervise placement of 5, gas cylinders along a 4-mile stretch of road near the trenches outside the Belgian town of Ypres. And then Haber waited at the front lines for weeks, until the prevailing wind turned northwest. Fritz Haber Haber had fought his own battle to just get the opportunity to try out the gas. Most of the German High Command was skeptical of poison gas as a weapon. Six months into the war, Haber had managed to convince only one commander on the Western Front to try out chlorine gas. After this chlorine attack killed more than 1, soldiers and injured many more, the lack of support changed dramatically. The first large-scale use of chemical weapons that day in ignited a chemical arms race among the warring parties. By the end of World War I, scientists working for both sides had evaluated some 3, different chemicals for use as possible weapons; around 50 of these poisons were actually tried out on the battlefield, says Joseph Gal , a historian of chemistry at the University of Colorado, Denver. The strategic power of chemical weapons in WWI was in the psychological terror they caused rather than the number of soldiers they killed: It might have done more damage, but both sides quickly developed protective gas masks that contained a wide variety of neutralizing agents. Even though poison gas was not an efficient killing weapon on WWI battlefields, its adoption set a precedent for using chemicals to murder en masse. In the past century, poison gas has killed millions of civilians around the world: By chance, the test siteâ€”what was to become known as Flanders Fieldsâ€”also happened to be of strategic importance. The Allies held Ypres, located about 25 miles from the Atlantic coast and near a major supply port. In the first weeks of WWI, Germany had marched, seemingly unstoppable, through Belgium and France, occupying land quickly and easily. But the Allied defense ramped up. Both sides capitalized on the Industrial Revolution to mass-produce weapons that could kill at close rangeâ€”grenades, machine guns, shell artillery, and moreâ€—but neither warring party could get the upper hand. Haber argued that chemical weapons could help end the impasseâ€”and the warâ€—in a matter of months. WWI raged on for another three-and-a-half years after chlorine gas was first deployed near Ypres. Then late that afternoon, around 5: The others, gasping, stumbling, with faces contorted, hands wildly gesticulating, and uttering hoarse cries of pain, fled madly through the villages and farms and through Ypres itself, carrying panic to the remnants of the civilian population and filling the roads with fugitives of both sexes and all ages. Hunter Haber and his scientific team had chosen chlorine gas for a few reasons. It was widely used in the German dye industry and thus widely available. From a practicality standpoint, chlorine gas was heavier than air and could sink into the trenches instead of disappearing up into the sky. Finally, the gas was a powerful irritant to eyes, noses, lungs, and throats. At high enough concentrations, exposed victims would die of asphyxiation. The gas attack decimated two French divisions, creating a huge gapâ€—5 miles wide and 2. The German Army then began to march into the emptied trenches. All of the animals had come out of their holes to die. Some had shot themselves. Then darkness began to fall, stalling the forward march of the German soldiers: They did not think it was safe to march into the night without backup, and the infantry had no gas protection. They and other Allied troops held their ground against the German Army until Allied reserves came to the rescue and forced the Germans backward. Wikimedia Commons The chlorine attack may have come out of the blue for the soldiers on the ground, but the idea of chemical warfare was not new to military strategists. Poisonous weapons had been used on and off for millennia: They were deployed in ancient Greece; the Chinese used them against Genghis Khan; and indigenous people in South America had long used plant extracts as poison on their darts. Chemical and biological warfare was considered such an imminent threat that just seven years before the start of WWI, Germany, France, Britain, and many other Western nations had implemented an international treaty against poisonous weapons. During the first weeks of the war, French troops broke that treaty when they deployed tear gas grenades on German soldiers, albeit with little consequence to troops. The German military also unleashed tear gas on both Russian and British troops early in the war. Both attempts failed because of technical difficulties: Of course, the entire world will rage about it at first and then imitate us. As news spread about the gas attacks, Allied chemists in Europe and North America had mobilized to help establish chemical weapons research programs, such as the U. After all, he says, this was , well before the introduction of top-notch analytical equipment. The rapid Allied response can be attributed to a combination of things, Ede explains. At the time, Germany was leading the world in chemical research. As a result, many international chemists had spent a sabbatical or part of their training in the country. George Nasmith, a sanitation expert from Toronto, Morin-Pelletier says. He spread the word that the poison gas was chlorine the evening of the attack, Morin-Pelletier says, as did a field ambulance doctor, Capt. He told his staff to urinate on their handkerchiefs and use them as a face cover when they went into affected areas to rescue the wounded, she adds. Scrimger knew that the ammonia in urine, a base, could help neutralize chlorine gas, which transformed into a strong acid in body tissue. These makeshift defenses helped defuse the new weaponâ€"a necessary step because the German Army would deploy chlorine five times more on the battlefield near Ypres in the weeks after the first gassing. Soldiers repair a telephone wire while surrounded by poison gas during training. Full-body, canvas cloaks with clear plastic viewing windows might have doubled as military-issue ghost costumes. But eventually, more sophisticated respirators were invented. These hoods, often made from canvas or rubber, had plastic viewing windows and featured tubing that connected to a canister, which filtered the incoming air. The filter in the canister was of key importance, Freemantle says. As new gases were deployed on the battlefield, the filters had to evolve to deactivate all manner of poisons. Both German soldiers and military dogs were issued protective gas masks. The first was activated charcoal, which features a highly porous structure that allowed air to pass yet also trapped larger poison gas molecules such as phosgene. The filters also contained acid-neutralizing agents, namely strong bases such as sodium hydroxide and calcium hydroxide. And finally, the masks contained oxidizing agents, such as potassium or sodium permanganate, which indiscriminately attacked and destroyed many poisons. Within a year of the first gas attack, the Allies had gas masks that were as protective as those worn by German soldiers, Freemantle says. A major challenge on both sides was ensuring soldiers actually kept their gas masks on. They hit on the idea of arsenic-containing compounds that could penetrate the filters. The first thing the soldiers would do was take off the gas mask. Then they would fire the real poison. The soldiers might also have simply stayed the course and kept their masks on. As a result, an overwhelming majority of chemical weapons used during the war were deployed in some form of artillery shell. But getting these poisons into the shells posed some major problems, from the danger to factory workers to the technical challenges of transporting the weapons to the front lines without leakage, Gal says. Chemical weapons containing halogens, for instance, attacked the iron-containing shells of the steel artillery. To address this issue, workers would line the shell containers with lead, ceramic, or glass to prevent corrosion, Gal explains. Historians estimate that between 35 million and 66 million shells filled with chemicals were fired altogether, Gal says. That is, until the summer of , when Germany introduced mustard gas. Within a year, the Allies were also deploying the poison. This liquid produces a toxic vapor that goes beyond hurting the eyes, nose, throat, and lungs, which are the standard gas target areas that can be protected with a mask. Mustard gas also attacks the skin. And it has a delayed reaction. Mustard gas victims with bandaged faces await transport. Trench Warfare in World War I. The skin blistered, the eyes became extremely painful and nausea and vomiting began. Worse, the gas attacked the bronchial tubes, stripping off the mucous membrane. The pain was almost beyond endurance and in most cases [victims] had to be strapped to their beds. Victims were often temporarily and sometimes permanently blind, and they took weeks, sometimes months, to recover, bogging down frontline medical facilities. Mustard gas was also persistent for weeks in the environment. Troops could be marching through contaminated areas, unaware that they were being exposed. After returning to their trenches or barracks, they could then contaminate other soldiers many hours before their own blistering and blindness began. A vast majority of WWI historians argue that chemical weapons had no decisive effect on the outcome of the war. Chemical Warfare in the First World War. Haber was correct that machine guns, high explosives, and artillery shells led to far more casualties and deaths than chemical weapons: As a young boy in Belgium, he played in Flanders Fields and grew up listening to local veterans talk about the First World War. Postwar public perception of chemical warfare in the U. The public perception is that it is evil and unsportsmanlike. One chemist, Harry Holmes, argued in both the New York Times and Scientific American that the public would be less afraid of chemical warfare if it could be demonstrated scientifically that defense against attack was an easy matter. Here, he was absolutely correct. Today, even though chemical weapons disarmament treaties such as the Geneva Protocol and the Chemical Weapons Convention have been drafted and signed, national armies and terrorists alike have continued to deploy poisonous compounds on soldiers and civilians. He maintained that chemical warfare was an ethical wartime weapon until his death. Certainly, he knew that trying to undo the precedent of chemical warfare would be as difficult as stuffing chlorine gas back into a cylinder buried in the mud in Flanders Fields.

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Chapter 5 : Chemical Warfare Agents: Chemistry, Pharmacology, Toxicology, and - Google Books

Brief history and use of chemical warfare agents in warfare and terrorism / Harry Salem, Andrew L. Ternay, Jr., and Jeffery K. Smart --The chemistry of chemical warfare agents / Peter Kikilo, Vitaly Fedorenko, and Andrew L. Ternay, Jr. --Chemical warfare agent threat to drinking water / Harry Salem [and others] --Health effects of low-level.

Weapons of World War I Tear gas[edit] The most frequently used chemicals during World War I were tear-inducing irritants rather than fatal or disabling poisons. The stocks were rapidly consumed and by November a new order was placed by the French military. As bromine was scarce among the Entente allies, the active ingredient was changed to chloroacetone. Large-scale use and lethal gases[edit] The first instance of large-scale use of gas as a weapon was on 31 January , when Germany fired 18, artillery shells containing liquid xylyl bromide tear gas on Russian positions on the Rawka River , west of Warsaw during the Battle of Bolimov. Instead of vaporizing, the chemical froze and failed to have the desired effect. At high concentrations and prolonged exposure it can cause death by asphyxiation. This is a horrible weapon Surviving defenders drove back the attack and retained the fortress. Germany used chemical weapons on the eastern front in an attack at Rawka , south of Warsaw. The Russian army took 9, casualties, with more than 1, fatalities. In response, the artillery branch of the Russian army organised a commission to study the delivery of poison gas in shells. Men who stood on the parapet suffered least, as the gas was denser near the ground. The worst sufferers were the wounded lying on the ground, or on stretchers, and the men who moved back with the cloud. The gas produced a visible greenish cloud and strong odour, making it easy to detect. It was water-soluble, so the simple expedient of covering the mouth and nose with a damp cloth was effective at reducing the effect of the gas. It was thought to be even more effective to use urine rather than water, as it was known at the time that chlorine reacted with urea present in urine to form dichloro urea. The Germans issued their troops with small gauze pads filled with cotton waste, and bottles of a bicarbonate solution with which to dampen the pads. Immediately following the use of chlorine gas by the Germans, instructions were sent to British and French troops to hold wet handkerchiefs or cloths over their mouths. Simple pad respirators similar to those issued to German troops were soon proposed by Lieutenant-Colonel N. These pads were intended to be used damp, preferably dipped into a solution of bicarbonate kept in buckets for that purpose; other liquids were also used. Because such pads could not be expected to arrive at the front for several days, army divisions set about making them for themselves. Locally available muslin, flannel and gauze were used, officers were sent to Paris to buy more and local French women were employed making up rudimentary pads with string ties. Other units used lint bandages manufactured in the convent at Poperinge. Pad respirators were sent up with rations to British troops in the line as early as the evening of 24 April. The response was enormous and a million gas masks were produced in a day. By 6 July , the entire British army was equipped with the more effective " smoke helmet " designed by Major Cluny MacPherson , Newfoundland Regiment , which was a flannel bag with a celluloid window, which entirely covered the head. The race was then on between the introduction of new and more effective poison gases and the production of effective countermeasures, which marked gas warfare until the armistice in November It is a cowardly form of warfare which does not commend itself to me or other English soldiers We cannot win this war unless we kill or incapacitate more of our enemies than they do of us, and if this can only be done by our copying the enemy in his choice of weapons, we must not refuse to do so. Chlorine, codenamed Red Star, was the agent to be used tons arrayed in 5, cylinders , and the attack was dependent on a favourable wind. Subsequent retaliatory German shelling hit some of those unused full cylinders, releasing gas among the British troops. The masks got hot, and the small eye-pieces misted over, reducing visibility. Some of the troops lifted the masks to get fresh air, causing them to be gassed. More deadly gases[edit] Plate I, Microscopic section of human lung from phosgene shell poisoning, American Red Cross and Medical Research Committee, An Atlas of Gas Poisoning, The deficiencies of chlorine were overcome with the introduction of phosgene , which was prepared by a group of

French chemists led by Victor Grignard and first used by France in Phosgene was sometimes used on its own, but was more often used mixed with an equal volume of chlorine, with the chlorine helping to spread the denser phosgene. It had a potential drawback in that some of the symptoms of exposure took 24 hours or more to manifest. This meant that the victims were initially still capable of putting up a fight; this could also mean that apparently fit troops would be incapacitated by the effects of the gas on the following day. The modified PH Gas Helmet , which was impregnated with phenate hexamine and hexamethylene tetramine urotropine to improve the protection against phosgene, was issued in January Mustard gas[edit] Plate X, Microscopic section of human lung from mustard gas poisoning, American Red Cross and Medical Research Committee, An Atlas of Gas Poisoning, The most widely reported and, perhaps, the most effective chemical agent of the First World War was sulfur mustard , known as "mustard gas". It is a volatile oily liquid. Delivered in artillery shells, mustard gas was heavier than air, and it settled to the ground as an oily liquid. Once in the soil, mustard gas remained active for several days, weeks, or even months, depending on the weather conditions. Mustard gas caused internal and external bleeding and attacked the bronchial tubes, stripping off the mucous membrane. This was extremely painful. Fatally injured victims sometimes took four or five weeks to die of mustard gas exposure. Great mustard-coloured blisters, blind eyes, all sticky and stuck together, always fighting for breath, with voices a mere whisper, saying that their throats are closing and they know they will choke. Gas was employed primarily on the Western Frontâ€"the static, confined trench system was ideal for achieving an effective concentration. Germany also used gas against Russia on the Eastern Front , where the lack of effective countermeasures resulted in deaths of over 56, Russians, [42] while Britain experimented with gas in Palestine during the Second Battle of Gaza. Most of the manufactured gas was never used. It took the British more than a year to develop their own mustard gas weapon, with production of the chemicals centred on Avonmouth Docks. The Allies mounted more gas attacks than the Germans in and because of a marked increase in production of gas from the Allied nations. Germany was unable to keep up with this pace despite creating various new gases for use in battle, mostly as a result of very costly methods of production. Entry into the war by the United States allowed the Allies to increase mustard gas production far more than Germany. When the United States entered the war, it was already mobilizing resources from academic, industry and military sectors for research and development into poison gas. By the time of the armistice on 11 November , a plant near Willoughby, Ohio was producing 10 tons per day of the substance, for a total of about tons. It is uncertain what effect this new chemical would have had on the battlefield, as it degrades in moist conditions. At that time, chemical weapon agents inflicted an estimated 1. The British used poison gas, possibly adamsite , against Russian revolutionary troops beginning on 27 August [54] and contemplated using chemical weapons against Iraqi insurgents in the s; Bolshevik troops used poison gas to suppress the Tambov Rebellion in , Spain used chemical weapons in Morocco against Rif tribesmen throughout the s [55] and Italy used mustard gas in Libya in and again during its invasion of Ethiopia in Public opinion had by then turned against the use of such weapons which led to the Geneva Protocol , an updated and extensive prohibition of poison weapons. The Protocol, which was signed by most First World War combatants in , bans the use but not the stockpiling of lethal gas and bacteriological weapons. Most countries that signed ratified it within around five years; a few took much longer â€" Brazil, Japan, Uruguay, and the United States did not do so until the s, and Nicaragua ratified it in In both Axis and Allied nations, children in school were taught to wear gas masks in case of gas attack. Germany developed the poison gases tabun , sarin , and soman during the war, and used Zyklon B in their extermination camps. Neither Germany nor the Allied nations used any of their war gases in combat, despite maintaining large stockpiles and occasional calls for their use. Britain made plans to use mustard gas on the landing beaches in the event of an invasion of the United Kingdom in Gas shock was as frequent as shell shock.

Chapter 6 : Chemical Warfare Agents (ebook) by James A. Romano Jr. |

Following a brief history of chemical warfare, 24 chapters address the chemistry of chemical warfare agents; chemical warfare agent threats to drinking water; health effects of low-level exposure to nerve agents; toxicokinetics of nerve agents; application of genomic, proteomic, and metabolomic technologies to the development of countermeasures.

Page xvi Share Cite Suggested Citation: The National Academies Press. The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance. This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. Any opinions, findings, conclusions, or recommenda- tions expressed in this publication are those of the author s and do not necessarily reflect the view of the organizations or agencies that provided support for this project. Additional copies of this report are available from the Board on Environmental Studies and Toxicol- ogy, Constitution Ave. Copyright by the National Academy of Sciences. Printed in the United States of America. Food and Drug Administration, Jefferson, Ark. Army Environmental Hygiene Agency Toxicology Division Permissible Exposure Levels and Emergency Exposure Guidance Levels for Selected Airborne Contaminants xii The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in , the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Alberts is president of the National Academy of Sciences. The National Academy of Engineering was established in , under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Wulf is president of the National Academy of Engineering. The Institute of Medicine was established in by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Fineberg is president of the Institutedicine. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Wulf are chair and vice chair, respectively, of the National Research Council. This information could aid in protecting soldiers in the event of a CW attack. Army by assessing the scientific validity of existing human-toxicity estimates for several CW agents. The report was authored by S. Army for providing background information. We are grateful for the assistance of the National Research Council staff in preparing this report. Maczka, program director for toxicology and risk assessment; Ruth E. Crossgrove, editor; Lucy V. Fusco, project assistant, and Catherine M. Kubik, senior program assistant. We especially wish to recognize the major contributions of the project director, Kulbir S. Finally, we would like to thank all the members of the subcommittee for their dedicated efforts throughout the development of this report.

DOWNLOAD PDF CHEMICAL WARFARE AGENT THREAT TO DRINKING WATER HARRY SALEM . [ET AL.]

Chapter 7 : Ricin - Wikipedia

Recommended field drinking water criteria for chemical agent sulfur mustard. Technical Report , AD A Fort Detrick, Frederick, MD: US Army Biomedical Research and Development Laboratory.

Chapter 8 : - NLM Catalog Result

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Chapter 9 : Superfund Site Profile | Superfund Site Information | US EPA

Ricin is a potent protein that acts as a toxin if inhaled, injected, or ingested. Ricin can be used as a chemical warfare agent and has been weaponized in the past; however, it is not considered practical nor likely to be a significant threat in drinking water.