



# RAD U SEKTORU KOMUNALNE OTPADNE VODE - PREGLED RIZIKA, ŠTETNOSTI I MERA BEZBEDNOSTI

## WORKING IN MUNICIPAL WASTEWATER SECTOR – REVIEW OF RISKS, HAZARDS AND SAFETY MEASURES

### APSTRAKT

Sigurnost zaposlenih koji su u kontaktu sa sirovim komunalnim otpadnim vodama veoma je zapostavljena istraživačka tema, posebno u zemljama koje nemaju odgovarajuće procese i postrojenja za prečišćavanje otpadnih voda. U Srbiji, najveće aglomeracije, poput Beograda, Novog Sada, Niša itd., imaju stare kanalizacione sisteme koji imaju nisku efikasnost, usled curenja, i mali kapacitet da apsorbiraju svu otpadnu vodu generisanu u urbanoj sredini. Svi ovi uslovi, doveli su do toga da je izloženost kanalizacionih radnika riziku i opasnostima, koje sirova komunalna otpadna voda sa sobom nosi, visoka. Zaposleni u sektoru vode koji su u direktnom kontaktu s komunalnim kanalizacionim vodama izloženi su raznim hemijskim i biološkim rizicima i opasnostima, ali i potencijalnim nezgodama i profesionalnim fizičkim povredama. U sektoru komunalnih otpadnih voda, izloženost štetnom radnom okruženju može prouzrokovati kardiovaskularnu degeneraciju mišićno-koštanog sistema, virusne i bakterijske infekcije, iritacije i degeneracije integumentarnog sistema i mnoga druga stanja i povrede. Rizik i opasnosti od izlaganja u velikom broju slučajeva se mogu sprečiti, ako se primene detaljne analize, sveobuhvatne inženjerske i regulatorne mere, redovno i kontinuirano proveravanje i ispitivanje zdravlja zaposlenih. Prema prethodnim istraživanjima, sirova komunalna otpadna voda sadrži razne opasne hemijske supstance koje mogu biti izuzetno štetne ako dođe do njihove inhalacije, ingestije ili direktnog dodira sa kožom (Bisfenol A, ftalati, pesticidi, Benzen, Toluen, vodonik/sulfid i druge).

**Ključne reči:** sirova komunalna otpadna voda, fizičke, hemijske i biološke štetnosti i rizici, mere bezbednosti i zaštite.

### ABSTRACT

The security and safety of workers in contact with raw municipal wastewater is highly neglected research topic, especially in countries that do not have suitable wastewater treatment processes and plants. In Serbia, the biggest agglomerations, such as Belgrade, Novi Sad, Niš etc., have old sewage systems that have low efficiency, due to leakage, and low capacity to absorb all off the generated wastewater in the city. All that, makes the exposure of workers in the sewage sector to risks and hazards, which the raw municipal wastewater carries, significantly high. The employees in the water sector that are in direct contact with municipal sewage are exposed to diverse chemical and biological risks and hazards, but also to potential accidents and occupational physical injuries. In municipal wastewater sector, the exposure to harmful working environment can cause cardiovascular musculoskeletal degeneration, viral and bacterial infections, irritations and degenerations integumentary system and many other conditions and injuries. The vast majority of risks and hazards can be prevented if the vigorous analyses, comprehensive engineering and regulatory measures, regular and continual screening and examination of employees health. According to the previous research, the raw municipal wastewater contains diverse chemical hazardous substances that can be extremely harmful if it comes to inhalation, ingestion or direct skin contact (Bisphenol A, phthalates, pesticides, Benzene, Toluene, hydrogen-sulphide and other).

**Key words:** raw municipal wastewater, physical, chemical, biological risks and hazards, safety and protection measures.

## 1. UVODNA RAZMATRANJA

Sigurnost i zaštita zaposlenih koji su u kontaktu sa sirovim otpadnim vodama (OV) veoma je zapostavljena tema, kako istraživačka tako i profesionalna, posebno u zemljama koje nemaju odgovarajuće sisteme za kanalizaciju, ni procese i postrojenja za prečišćavanje otpadnih voda.

U Srbiji, najveće aglomeracije, poput Beograda, Novog Sada, Niša itd., nemaju adekvatna ili nikakva postrojenja za prečišćavanje komunalne otpadne vode,

## 1. INTRODUCTION

Security and safety of the employees that are in contact with raw wastewater is highly neglected topic, research and professional wise, especially in countries that do not have suitable sewage channelling, wastewater treatment processes and plants.

In Serbia, the biggest agglomerates, such as Belgrade, Novi Sad, Niš etc., have no wastewater treatment plants for municipal wastewater, and

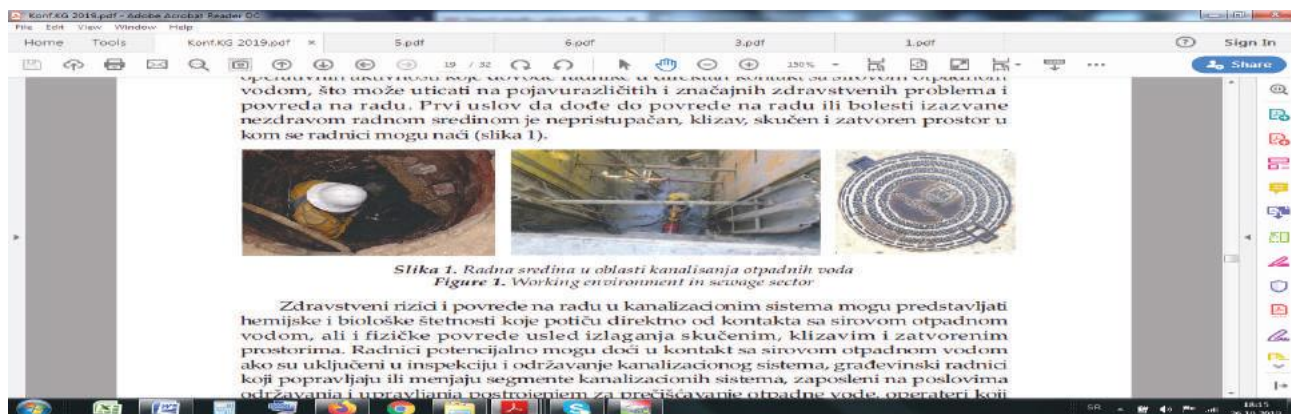
<sup>1</sup> Univerzitet u Novom Sadu, Fakultet tehničkih nauka, Departman za inženjerstvo zaštite životne sredine i zaštite na radu, Trg Dositeja Obradovića 6, Novi Sad

i imaju stare kanalizacione sisteme (50+ godina). Stari kanalizacioni sistemi su mešoviteg tipa koji prikupljaju industrijsku, poljoprivrednu otpadnu vodu i otpadnu vodu iz domaćinstva, što čini komunalnu otpadnu vodu posebno tešku tečnu mešavinu za tretiranje, u kvalitativnom i kvantitativnom smislu. Kanalizacioni sistemi imaju nisku efikasnost, usled habanja i curenja cevi, i nizak kapacitet da apsorbuju svu otpadnu vodu generisanu u urbanoj sredini, usled proširenja gradskih urbanih sredina i povećanog broja populacije. Svi ovi uslovi, omogućavaju visoku izloženost radnika riziku i opasnostima koje sirova komunalna otpadna voda sa sobom nosi. Zaposleni u sektoru otpadne vode su odgovorni za dnevno funkcionisanje, održavanje, rešavanje problema i havarija u komunalnim, industrijskim i drugim sistemima odvođenja i tretiranja otpadnih voda. Radnici u kanalizacionim sistemima izloženi su visokom riziku od izloženosti sirovoj otpadnoj vodi, što može dovesti do potencijalnog unosa patogena, toksina i industrijskih otpada (Slika 1). Posebno zapostavljena posledica izloženosti sirovoj otpadnoj vodi su hronični efekti i posledice dugoročne ekspozicije. Nekoliko studija o dugoročnim efektima izloženosti prikazuju povećanje smrtnosti i pojave kancera (grkljan, jetra, prostata, nos i sinusi, stomak) [1,2,3].

Prema podacima preuzetim od operatera, najzastupljenije povrede nastaju usled okliznuća i pada, a najčešće fizičke povrede su povrede leđa i uganuća zglobova. Ima veoma malo informacija o dugoročnim efektima izloženosti OV, hemikalijama i patogenima koje nosi. U sektoru OV je veća frekvencija povreda i oboljenja u odnosu na druge privredne sektore [4].

have old sewage systems (50+ years). The old sewage systems are of mixed type which abstracts domestic, agricultural and industrial wastewater, making the wastewater a very hard liquid mixture to treat, in terms of quality and quantity. The sewage systems have low efficiency, due to old piping and leakage, and low capacity to absorb all off the generated wastewater, due to city expansion and population growth. Thus, makes the exposure of workers in the sector of wastewater to diverse health risks and hazards considerably high. Workers in the wastewater sector are responsible for the day-to-day operation, maintenance, trouble-shooting and handling of special problems of municipal, industrial, and other wastewater systems. The employees in wastewater sector are in high risk of exposure to raw sewage which can lead to potential intake of pathogens, toxins, and industrial wastes (Figure 1). The mostly neglected consequences of exposure to raw sewage are long-term exposure and chronically effects. A number of the studies on long-term effects have indicated an increase in the total mortality and cancer (laryngeal, liver, prostate gland, nose and nasal sinuses, and the stomach) [1,2,3].

Slips and trips are the number one cause of injury, and the most common physical injuries are strains and sprains to the back, according to the reports of WWTP operators. There is little information about the long-term effects of exposure to wastewater, chemicals and pathogens in it. Generally, there is a much higher rate of injury than in other occupations [4].



**Slika 1.** Zaposleni u radnom prostoru u sektoru komunalne otpadne vode (KOV)

**Figure 1.** Employees in the working spaces in municipal wastewater (MWW) sector

## 2. RIZICI I ŠTETNOSTI U SEKTORU KOMUNALNE OTPADNE VODE – FIZIČKE, HEMIJSKE I BIOLOŠKE

Izloženost toksičnim supstancama, patogenima i drugim hazardnim materijalima može imati značajane dugoročne efekte i doživotna oštećenja. Klizava i kontaminirana radna sredina može dovesti do povreda i bolesti glave, stopala, nogu, uključujući lomove, posekotine i druge ozbiljne

## 2. RISKS AND HAZARDS IN MUNICIPAL WASTEWATER SECTOR – PHYSICAL, CHEMICAL AND BIOLOGICAL

Exposure to toxic substances, pathogens and other hazardous materials can have a significant long-term impacts and lifelong disabilities. Slippery and contaminated work environment can lead to injury to the head, feet, including crush injuries, lacerations etc. The employees in the wastewater sector that are

povrede. Zaposleni u sektoru otpadnih voda koji su u direktnom kontaktu s komunalnom kanalizacijom izloženi su raznim hemijskim i biološkim opasnostima, ali i nesrećama i fizičkim povredama na radu. Izloženost štetnom radnom okruženju može prouzrokovati kardiovaskularnu degeneraciju mišićno-koštanog sistema, virusne i bakterijske infekcije, iritacije i degeneracije integumentarnog sistema i mnoga druga stanja i povrede [5]. Radnici u kanalizacionim sistemima mogu biti izloženi štetnim supstancama i patogenima udisanjem aerosola i gasova, dermalnim kontaktom i gutanjem. Direktna dugotrajna i kratkotrajna izloženost zaposlenih omogućena je ograničenim i zatvorenim prostorima karakterističnim za kanalizacione sisteme, kolektore i postrojenja za prečišćavanje otpadne vode.

Fizičke povrede radnika u sistemima za prikupljanje otpadnih voda su raznovrsne i mogu se kretati od lakih do smtonosnih, jer je radno okruženje obično ograničeni prostori koji su visoko hemijski i biološki neprijateljski i kontaminirani.

Kontakt kože je najčešći put infiltracije kako hemikalija, tako i patogena. To uključuje prskanje u usta, oči ili na kožu. Hemikalije se mogu apsorbirati kroz kožu iz dodira sa otpadnom vodom ili muljem. Patogeni organizmi mogu ući u telo putem posekotina, ogrebotina ili uboda igala, prilikom otvaranja šahta i rešetki [6].

Prema prethodnim istraživanjima, sirova komunalna otpadna voda sadrži razne opasne hemijske supstance koje mogu biti izuzetno štetne ako se radi o udisanju, gutanju ili direktnom dodiru sa kožom [7]. Većina identifikovanih supstanci imaju mutagene, ksenoestrogene, perzistentne, pseudo-perzistentne, kancerogene i/ili toksične karakteristike; u skladu sa tim ih regulišu i nadgledaju nacionalna i međunarodna tela i istraživački instituti. Fenol, 4,4'-(1-metiletiliden)-bis (bisfenol A), di-oktil ftalat (DEHP), di-n-butyl ftalat (DBP) i organohlorini pesticidi su neke od supstanci koje se obično detektuju u komunalnim otpadnim vodama generisanih u Novom Sadu.

*Fenol, 4,4'-(1-metiletiliden)-bis* ili opšte poznat kao bisfenol A (BPA), se široko koristi kao sirovina za proizvodnju epoksidne i polikarbonatne smole, u kontejnerima za skladištenje hrane i pića, kao premaz za unutrašnjost metalnih proizvoda i u mnoge druge svrhe. Uprkos širokoj upotrebi u različitim proizvodima, sigurnosno-tehnički list za Bisfenol A veoma je zabrinjavajuć. BPA je označena signalnom rečju *opasnost* i upozorenjem - može izazvati alergijsku kožnu reakciju (H317), ozbiljno oštećenje oka (H318), može izazvati iritaciju disanja (H335), može oštetiti i uticati na plodnost ili nerođeno dete (H360), otrovno za akvatične sredine s dugotrajnim dejstvom (H411). *Ftalati DEHP i DBP* su takođe supstance u širokoj komercijalnoj upotrebi, kao esteri ftalne kiseline, koji se uglavnom koriste kao plastifikatori. Ftalati se dodaju plastici da bi se povećala njihova fleksibilnost, transparentnost i dugotrajnost, i koriste se

in direct contact with municipal sewage are exposed to diverse chemical and biological hazards, but also to accidents and physical occupational injuries. The exposure to harmful working environment can cause cardiovascular musculoskeletal degeneration, viral and bacterial infections, irritations and degenerations integumentary system and many other conditions and injuries [5]. Sewage workers may be exposed to harmful substances and pathogens by inhalation of aerosols and gasses, by dermal contact, and by ingestion. The direct long and short-term exposure of employees is enabled by restricted and closed spaces which are characteristic for sewage systems, collectors and wastewater treatment plants.

Physical injuries for workers in sewage collection systems are vast and can range from light to terminal, as the working environment is usually restricted spaces which are highly chemically and biologically hostile and contaminated.

The skin contact is the most common route of entry for both chemicals and pathogens. This includes being splashed in the mouth, eyes or on the skin. Chemicals can be absorbed through the skin from contact with wastewater or sludge. Pathogenic organisms can enter the body through cuts, abrasions or needle sticks such as when removing screenings from a bar screen [6].

According to the previous research, the raw municipal wastewater contains diverse chemical hazardous substances that can be extremely harmful if it comes to inhalation, ingestion or direct skin contact [7]. The most of the identified substances have mutagenic, xenoestrogenic, persistent, pseudo-persistent, carcinogenic and/or toxic characteristics; accordingly they are regulated and surveyed by national and international bodies and research institutes. Phenol, 4,4'-(1-methylethylidene)-bis (Bisphenol A), di-octyl phthalate (DEHP), di-n-butyl phthalate (DBP), organochlorine pesticides are some of the substances commonly detected in municipal wastewater of Novi Sad.

*Phenol, 4,4'-(1-methylethylidene)bis* or commonly known as Bisphenol A (BPA), widely used as raw material for epoxy and polycarbonate resin, in containers that store food and beverages, coat the inside of metal products, and many other purposes. In spite of its wide use in different products, the safety data sheet for Bisphenol A is highly concerning. The BPA is identified with a signal word *danger*, and hazard statements – may cause an allergic skin reaction (H317), causes serious eye damage (H318), may cause respiratory irritation (H335), may damage fertility or the unborn child (H360), toxic to aquatic life with long lasting effects (H411). *Phthalates* DEHP and DBP are also highly used commercial chemicals, are esters of phthalic acid, mainly used as plasticizers. The phthalates are added to plastics to increase their flexibility, transparency, durability, and longevity, and are used primarily to soften polyvinyl chloride (PVC).





prevashodno za omekšavanje polivinilhlorida (PVC). Ftalati su označeni kao ozbiljni hazardi po zdravlje i štetni za životnu sredinu, sa upozorenjima da mogu oštetiti i uticati na plodnost ili nerođeno dete (H360), vrlo toksične za akvatične sisteme (H400). *Organohlorini pesticidi* su opšte poznate opasne supstance, visoko regulisane, i identifikovane kao akutno toksične supstance za izraženim iritirajućim efektima na različite ljudske organe i sisteme, kao i različite kancerogene, teratogene i hazardne efekte.

Ozbiljne zdravstvene probleme izazivaju prašina, bio-aerosoli, štetni gasovi. Posledice udisanja gasova značajno zavise od koncentracije, koje mogu varirati od 10 do preko 1000 ppm, ali i od prostora u kom se radnik nalazi. Inhalacija visokih koncentracija gasova, u kratkom vremenskom periodu, može da izazove anoksiju, i smrt usled gušenja. Izražena je povišena sklonost prema astmi i hroničnim promenama disajnih funkcija. Istraživanja ukazuju da radnici koji su u direktnom kontaktu sa OV iz domaćinstva imaju povišen rizik od dobijanja infektivnih bolesti za 15%, dok je 20% ispitivanih radnika bilo pozitivno na infekciju leptospirozom [7]. U vazduhu najčešće su identifikovani benzen, toluen, vodonik-sulfid i druge visoko toksične supstance [8].

*Benzen* je označen signalnom rečju *opasnost* kao zapaljiv, ozbiljan rizik i opasnost po zdravlje/opasan po ozonski omotač i upozorenja - lako zapaljiva tečnost i para (H225), može biti smrtonosan ako se proguta i/ili uđe u disajne puteve (H304), izaziva kožu iritacija (H315) izaziva ozbiljnu iritaciju oka (H319), može izazvati genetska oštećenja (H340), može izazvati rak (H350), oštećenje organa kroz duže ili ponovljeno izlaganje (H372). *Toluen* je takođe, označen signalnom rečju *opasnost* kao zapaljiv, ozbiljan rizik i opasnost po zdravlje/opasan po ozonski omotač i upozorenja - lako zapaljiva tečnost i para (H225), može biti smrtonosan ako se proguta i/ili uđe u disajne puteve (H304), izaziva kožu iritacija (H315), može izazvati pospanost ili vrtoglavicu (H336), za koju se sumnja da oštećuje i utiče na plodnost ili nerođeno dete (H361), može prouzrokovati oštećenje organa (centralni nervni sistem, jetra, srce) kroz dugotrajno ili ponavljano izlaganje (H373), štetnost po akvatični ekosistem (H402). Opasnosti *vodonik-sulfida* ( $H_2S$ ) značajno zavise od koncentracije, varirajući od simptoma iritacije očiju, preko plućnog edema, do glavobolje, vrtoglavice, konjuktivitisa, fotofobije, suzenja, bola, zamagljenog vida i gastrointestinalnih poremećaja, u nekim slučajevima bronhitisom i bronhijalnom pneumonijom i smrću. Ako se udiše, prvo dovodi do umora, jer u vodi reaguje sa enzimima u krvotoku i inhibira ćelijsko disanje što rezultira plućnom paralizom, naglim kolapsom i smrću.

Mikrobna sredstva uključuju gram negativne bakterije, kao što su *Klebsiella* spp i *Escherichia coli*, *Clostridium perfringens*, fekalni streptokoki, *Leptospira* spp i *Aspergillus* spp. Dodatni i najčešći patogen u KOV su mikobakterijska tuberkuloza, enterovirus gastroenteritisa, rotavirusi, infektivni i serumski

The phthalates are indentified as serious health hazard and hazardous to the environment, and hazard statements –may damage fertility or the unborn child (H360), very toxic to aquatic life (H400). *Organohlorine pesticides* are widely know hazardous sunstances highly regulated, and indentified as acutely toxic, known irritants of vast variaty of human organs and systems, and diverse carcinogenic, teratogenic and hazardous effects.

Dust, bio-aerosols, harmful gases can cause serious respiratory health problems and issues, as well as pulmonary function impairment. The effects of gas inhalation highly depend on concentration, which can vary from 10 to over 1000 ppm, but also on the area in which the worker is located (open or closed spaces). Inhalation of high gas concentrations over a short period of time can cause anoxia, and death by suffocation. There is an increased tendency for asthma and chronic changes in respiratory function. Research indicates that workers who are in direct contact with MWW have an increased risk of getting infectious diseases by 15%, while 20% of the workers surveyed were positive for leptospirosis infection [5]. In air mosly detected substances are benzene, toluene, hydrogen-sulphide and others highly toxic substances [8].

*Benzene* is indentified with a signal word danger as flammable, serious health hazard and health hazard/hazardous to the ozone layer, and hazard statements – highly flammable liquid and vapour (H225), may be fatal if swallowed and enters airways (H304) causes skin irritation (H315) causes serious eye irritation (H319), may cause genetic defects (H340), may cause cancer (H350) causes damage to organs through prolonged or repeated exposure (H372). *Toluene* is, also, indentified with a signal word danger as flammable, serious health hazard and health hazard/hazardous to the ozone layer, and hazard statements – highly flammable liquid and vapour (H225), may be fatal if swallowed and enters airways (H304), causes skin irritation (H315), may cause drowsiness or dizziness (H336), suspected of damaging fertility or the unborn child (H361), may cause damage to organs (central nervous system, liver, heart) through prolonged or repeated exposure (H373), harmful to aquatic life (H402). The hazards of *hydrogen-sulphide* ( $H_2S$ ) are highly concentration dependable, varying the symptoms from eye irritation, over pulmonary edema, to headache, dizziness, conjunctivitis, photo phobia, tearing, pain, blurred vision and gastroenteric disorder, followed in some cases by bronchitis and bronchial pneumonia and death. If inhaled it leads first to fatigue, as it reacts with enzymes in the bloodstream and inhibits cellular respiration resulting in pulmonary paralysis, sudden collapse and death.

The microbial agents include gram negative bacilli such as *Klebsiella* spp and *Escherichia coli*, *Clostridium perfringens*, faecal streptococci, *Leptospira* spp, hepatitis virus, enterovirus, and *Aspergillus* spp. Additional and most common pathogen in MWW

hepatitis, adenovirusi, reovirusi, koronavirusi, amebiasis, meningoencefalitis, parazitski crvi, gljivice i drugo. Pored toga, radnici mogu biti izloženi agensima koji nastaju kao proizvod prethodno navedenih organizama, uključujući egzotoksine, endotoksine, butil acetat i vodonika sulfid [3,9,10]

### 3. MERE ZAŠTITE I SIGURNOSTI U SEKTORU KOMUNALNE OTPADNE VODE

Veliki udeo rizika i opasnosti izloženosti može se sprečiti detaljnim analizama radnog mesta i procesa rada, sveobuhvatnim inženjerskim i regulatornim merama, redovnim i stalnim pregledom i ispitivanjem zdravlja zaposlenih. Sektor OV nije novi i nepoznati sektor, ali sistemu upravljanja i zaštite zdravlja i bezbednosti na radu nedostaje inovacija i re-evaluacije u cilju bolje zaštite zaposlenih na određenoj lokaciji, koristeći nova znanja i tehnologije.

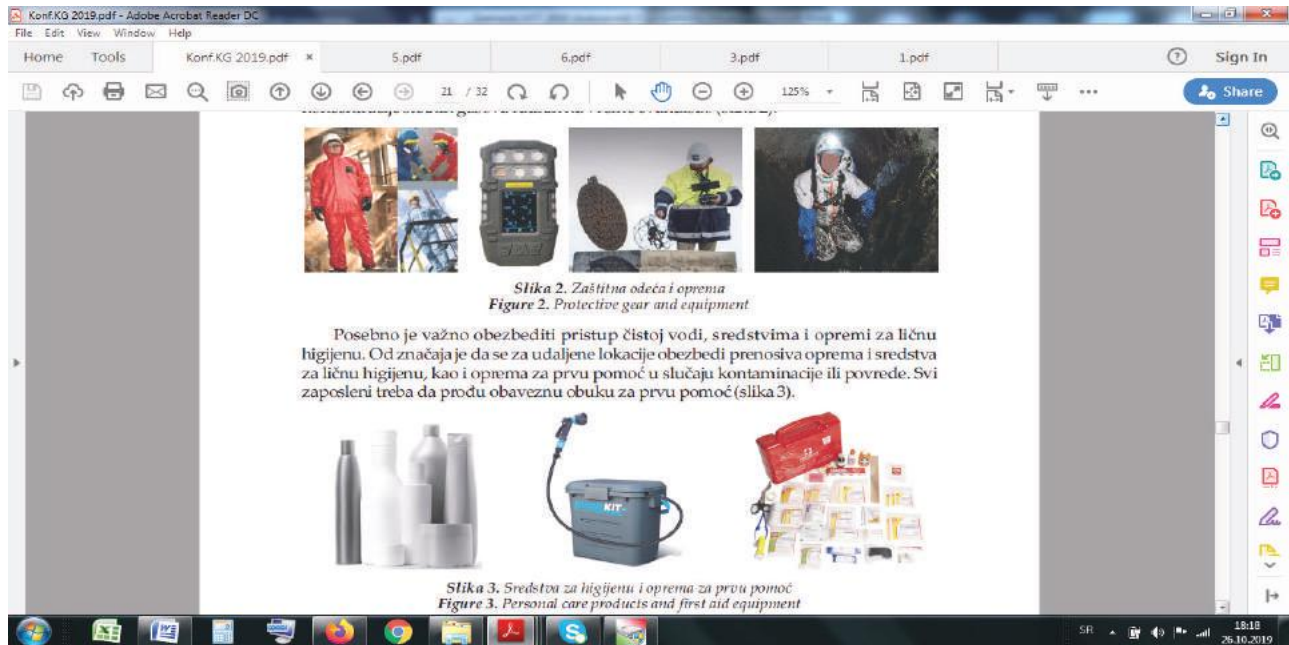
Prevenција štetnosti i minimizacija rizika se postiže putem detaljnih i sveobuhvatnih inženjerskih i regulatornih mera, a fatalni ishodi se mogu preduprediti redovnim i kontinualnim medicinskim preventivnim pregledom. Kako je raznovrsnost mikroorganizama u OV velika i kvalitet OV se često menja, potrebno je minimizirati direktan kontakt radnika sa štetnim materijama iz OV. U slučaju gde je to moguće treba da se koristi oprema sa daljinskim upravljanjem za inspekciju i kontrolu rada sistema. U slučaju kada to nije moguće, zaštitna oprema mora biti prilagođena poslu koji se obavlja i prostoru kojem se pristupa, a sastoji se od zaštitnih vodoopornih i abrazivno-rezistentnih rukavica, čizama i radnog odela sa kapuljačom, šlema sa baterijskom lampom, zaštitnih naočara i maske za lice. U slučaju dužeg boravka u kanalizacionom sistemu, posebno u zatvorenom prostoru, potrebno je obezbediti i personalni prenosivi detektor gasova, da bi se u slučaju pojave visoke koncentracije štetnih gasova radnik na vreme evakuisao (slika 2). Posebno je važno obezbediti pristup čistoj vodi, sredstvima i opremi za ličnu higijenu. Od značaja je da se za udaljene lokacije obezbedi prenosiva oprema i sredstva za ličnu higijenu, kao i oprema za prvu pomoć u slučaju kontaminacije ili povrede.

are mycobacterium tuberculosis, gastroenteritis enteroviruses, rotaviruses, infectious and serum hepatitis, adenoviruses, reoviruses, coronaviruses, amebiasis, meningoencephalitis, parasitic worms, fungi and other. In addition, the workers may be exposed to such agents that may be produced by or from these organisms, including exotoxins, endotoxins, butyl acetate, and hydrogen sulphide [3,9,10]

### 3. MEASURES OF PROTECTION AND SAFETY

The vast majority of risks and hazards can be prevented by the vigorous analyses of work place and processes, comprehensive engineering and regulatory measures, regular and continual screening and examination of employees health. The wastewater sector is not a new and unknown sector, but the occupational health and safety management system (OHSMS) lacks innovation and re-evaluation for the purpose of better protection of employees on a specific location, using the new knowledge and technology. Harm prevention and risk minimization are achieved through detailed and comprehensive engineering and regulatory measures, and fatal outcomes can be prevented by regular and ongoing medical protective screening. As the diversity of microorganisms in MWW is high and the quality of MWW is often changing, it is necessary to minimize direct contact of workers with the harmful substances. Where possible, remote control equipment should be used to inspect and control the operation of the system. Where this is not possible, the protective equipment must be adapted to the work being carried out and to the accessed area, consisting of protective waterproof and abrasion resistant gloves, boots and a hooded work suit, a helmet with a flashlight, safety glasses and a mask for the face. In case of prolonged stay in the sewage system, especially indoors, a personal portable gas detector should be provided, so that in case of a high concentration of harmful gases the worker evacuates on time (Figure 2). It is especially important to provide access to clean water, personal hygiene products and equipment. It is imperative to provide portable equipment and personal hygiene equipment for remote locations, as well as first aid equipment in the event of contamination or injury.





Slika 2. Lična zaštitna oprema

Figure 2. Personal protective equipment

Svi zaposleni moraju biti obučeni za davanje prve pomoći i upoznati sa pravilima ponašanja u slučaju fizičkih, hemijskih ili bioloških štetnosti i povreda. Neophodno je da lična zaštitna oprema bude pravilno postavljena i prikladna za svakog zaposlenog koji je koristi. Svi zaposleni moraju biti obučeni za potrebe prve pomoći i upoznati sa pravilima ponašanja u slučaju fizičkih, hemijskih ili bioloških štetnosti i/ili povreda. Edukacija o ličnoj higijeni i bezbednim radnim navikama izuzetno je važna za minimiziranje kontakta sa kanalizacijom i za sprečavanje bolesti i povreda. Iako poslodavac snosi glavnu odgovornost, svi na radnom mestu trebaju biti oprezni i pridržavati se propisanih pravila ponašanja.

Predhodno planiranje, pažljivo vođena lična higijena i pravilna upotreba lične zaštitne opreme (LZO) mogu u velikoj meri umanjiti rizike povezane sa izlaganjem sirovoj kanizacionoj vodi. Od suštinskog je značaja da se radniku dostave informacije o smanjenju rizika od izloženosti i povreda. Koordinirani odnosi između poslodavaca i zaposlenih imaju za rezultat visoko efikasnu primenu zakonskih propisa o zaštiti na radu, kao što su bezbednost, zdravlje na radu i prekovremeni rad. Ovo je važno u sektorima sa visokom stopom povreda, kao što je sektor otpadne vode. Poslodavci i radnici treba da koordiniraju i sarađuju u procesu redovnog ažuriranja sigurnosnih praksi, procedura i obrazovanja. Važan i obavezan segment sistema upravljanja zaštitom zdravlja i zaštite na radu trebalo bi da budu sveobuhvatni zdravstveni skriningi i pregledi radnika. Skrining i lekarski pregled pre smeštanja na radno mesto moraju biti obavezni, radi utvrđivanja postojećeg zdravstvenog stanja zaposlenog. Za svako radno mesto sa visokim rizikom od izlaganja i hazarda treba razviti pogodan, specifičan i kontinualni plan zdravstvenih skrininga i lekarskih pregleda. Republika

It is imperative that personal protective equipment is fitted properly to the employee that is using it. All employees must be trained in first aid and familiar with the rules of conduct in the event of physical, chemical or biological harm and/or injury. Education about personal hygiene and safe work practices is extremely important to minimize contact with sewage and to prevent illnesses and injuries. While the employer bears the primary responsibility, everyone in the workplace needs to exercise caution.

Pre-planning, careful attention to personal hygiene and proper use of personal protective equipment (PPE) can greatly reduce the associated risks of exposure to sewage. It is essential that information be provided to the worker on reducing the risks of exposure and injury. Coordinated relations between employers and employees have a highly effective enforcement of legislated labor protections such as safety, health, and overtime regulations. This is important in the sectors with high injury rates such as wastewater. Employers and workers should coordinate and cooperate in the process of updating the safety practices, procedures and education on a regular basis. The important and obligatory segment of occupational health and safety management system (OHSMS) should be comprehensive health screenings and check-ups of workers. The pre-placement medical screening and medical examination should be mandatory, for the purpose of determination of pre-existing health status of the employee. For every high risk position should be developed suitable, workplace-specific and continuous health screening and check-up. The Republic of Serbia has a set of laws and by-laws related to the field of occupational safety and protection [11], which, with the additional



Srbija poseduje set zakonskih i podzakonskih akata koji se odnose na oblast bezbednosti i zaštite na radu [11], koji uz dodatnu primenu dobre prakse i prilagođenih pravilika predstavljaju osnov za ostvarenje bezbednog i zdravog radnog okruženja, ako se primenjuju. Zakon i prateća akta jasno i nedvosmisleno definišu prava i obaveze institucija, poslodavca i pojednica prilikom rada, kao i sve mere koje treba preduzeti u cilju minimizacije i upravljanja rizicima i hazardima na radnom mestu.

#### 4. ZAKLJUČNA RAZMATRANJA

Izlaganje kontaminiranoj sredini kanalizacionih sistema može izazvati ranovrsne bolesti i povrede. Povrede i rizici koje nosi kanalizacija je nemoguće u potpunosti eliminisati. Iz tog razloga, potrebno je posvetiti posebnu pažnju na bezbednost i zdravlje na radu. Minimizacija rizika i prevencija štetnosti se može postići jedino detaljnim i sveobuhvatnim inženjerskim i regulatornim merama, a fatalni ishodi se mogu preduprediti redovnim i kontinualnim medicinskim preventivnim pregledom. Inženjerske i regulatorne mere koje dovode do prevencije štetnosti i minimizacije rizika su one koje proizilaze iz potpunog razumevanja radnog mesta, prostora i supstanci sa kojima je radnik i osoblje u direktnom kontaktu. Zbog toga je dobra saradnja i koordinacija u odnosu poslodavac-zaposleni apsolutno neophodna. Za svako radno mesto sa visokim rizikom od izlaganja i hazarda treba razviti pogodan, specifičan i kontinualni plan zdravstvenih skrining i lekarskih pregled. Svi zaposleni moraju biti obučeni za davanje prve pomoći i upoznati sa pravilima ponašanja u slučaju fizičkih, hemijskih ili bioloških štetnosti i povreda. Republika Srbija poseduje set zakonskih i podzakonskih akata koji se odnose na oblast bezbednosti i zaštite na radu, koji uz dodatnu primenu dobre prakse i prilagođenih pravilika predstavljaju osnov za ostvarenje bezbednog i zdravog radnog okruženja, ako se primenjuju. Zakon i prateća akta jasno i nedvosmisleno definišu prava i obaveze institucija, poslodavca i pojednica prilikom rada, kao i sve mere koje treba preduzeti u cilju minimizacije i upravljanja rizicima i hazardima na radnom mestu.

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implementation of good practice and adapted rules, are the basis for the creation of a safe and healthy working environment, if implemented. The Law and the accompanying by-laws clearly and unambiguously define the rights and obligations of institutions, employers and individuals, as well as all measures that must be taken to minimize and manage risks and hazards in the workplace.

#### 4. CONCLUSIONS

Exposure to the environment in sewage systems can cause various diseases and injuries. The damages and risks posed by sewage are sometimes impossible to eliminate. For this reason, special attention should be paid to the health and safety at work. Risk minimization and harm prevention can only be achieved through detailed and comprehensive engineering and regulatory measures, and fatal outcomes can be prevented by regular and ongoing medical preventative screening. Engineering and regulatory measures that lead to prevention of the hazards and minimization of risk and risk factors are those that result from a complete understanding of the workplace, space and substances with which the employees are in direct contact. Which is why, the good cooperation and coordination on the relation employer-employee is absolute necessity. For every high risk position should be developed suitable, workplace-specific and continuous health screening and medical examination. All employees must be trained in first aid and familiar with the rules of conduct in the event of physical, chemical or biological harm and injury. In Serbia, there are legal regulations related to occupational safety, health and safety which must be regularly up-dated and comprehensively modified according to workplace-specific risks and hazards. In addition to which ethical measures must be applied, as well as good workplace safety and security specific practices. The Law and the accompanying by-laws clearly and unambiguously define the rights and obligations of institutions, employers and individuals, as well as all measures that must be taken to minimize and manage risks and hazards in the workplace.

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