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UTICAJ HIDRODINAMIKE NA BIOFILM U DISTRIBUTIVNIM SISTEMIMA VODE ZA PIĆE

THE EFFECT OF HYDRODINAMICS ON BIOFILMS IN THE DRINKING WATER DISTRIBUTION SYSTEMS

REZIME

Biofilm je prisutan ubikvitarno u distributivnim sistemima vode za piće i može izazvati različite probleme, kao što su pogoršanje biološkog kvaliteta vode (biološka nestabilnost), razvoj mirisa i ukusa, mikrobno izazvana korozija cevi i ostale neželjene pojave, pri čemu je veoma važna isporuka stabilne i zdravstveno bezbedne vode do potrošača. Hidrodinamika vodenih sredina ima značajan uticaj na razvoj i aktivnost biofilma. Međutim, na formiranje biofilma ne utiče samo jedan faktor, već biološki procesi u cevima zavise od kompleksnih interakcija mnogobrojnih faktora. Prema tome, neophodno je razumevanje interakcija svih faktora u cilju efikasne kontrole formiranja biofilma u distributivnom sistemu, a to obuhvata ispitivanje biofilma, biološke stabilnosti vode za piće i materijala u dodiru sa vodom za piće.

Ključne reči: biofilm, distributivni sistem vode za piće, brzina protoka, smicajni napon.

SUMMARY

Biofilm is present ubiquitously in the drinking water distribution systems and can cause various problems, such as deterioration of the biological water quality (biological instability), the development of smell and taste, microbially induced corrosion of pipes and other adverse events, and the delivery of stable and safe water to consumers is very important. Hydrodynamics of aquatic environments has a significant influence on the development and activity of biofilm. However, the biofilm formation is not affected just by one factor, but the biological processes in pipes depend on the complex interaction of many factors. Therefore, it is necessary to understand the interaction of all factors in order to effective control of the biofilm formation in the distribution system, which consists of an examination of biofilms, biological stability of drinking water and materials in contact with drinking water.

Key words: biofilm, drinking water distribution system, flow velocity, shear stress.

1. UVOD

Biofilm je prisutan ubikvitarno u distributivnim sistemima vode za piće, uključujući sve vlažne ili vodene sredine, čak i povremeno dehidrirane površine[1]. Usled velikog odnosa površine i zapremine cevovoda, više od 95% ukupne biomase nalazi se na zidovima cevi, dok manje od 5% se nalazi slobodno u vodi[2]. Bakterije biofilma žive u samoorganizovanoj, kooperativnoj zajednici mikroorganizama koje su pričvršćene za površine, granične površine ili međusobno povezane i ugrađene u matriks ekstracelularnih polimernih supstanci (EPS) mikrobnog porekla, te ispoljavaju izmenjene fenotipove s obzirom na brzinu rasta i transkripciju gena[3,4]. Bakterije najčešće egzistiraju u obliku biofilma[3], pri čemu se one razlikuju od planktonskih vrsta[4]. U distributivnim sistemima vode za piće, rast ćelija biofilma generalno premašuje brzinu rasta njihovih planktonskih formi[1].

Cevi i rezervoari u okviru distributivnih sistema čine kompleksnu mrežu nekontrolisanih fizičkih, hemijskih i

1. INTRODUCTION

Biofilm is present ubiquitously in the drinking water distribution systems, including all moist or aquatic environments, even occasionally dehydrated surfaces[1]. Due to the large ratio of surface to volume of pipelines, more than 95% of the total biomass is located on the pipe walls, while less than 5% is is present in water[2]. Bacteria living in biofilms are self-organized, cooperative community of microorganisms that are attached to the surfaces, boundary surfaces or interrelated and embedded in the matrix of extracellular polymeric substances (EPS) of microbial origin, and exhibit altered phenotypes due to growth rate and gene transcription[3,4]. Bacteria usually exist in the form of biofilm[3], where they differ from planktonic species[4]. In drinking water distribution systems, biofilm cell growth generally exceeds the rate of growth of their planktonic forms[1].

Pipes and tanks in the distribution system consists of a complex network of uncontrolled physical, chemical

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