Popular summary

Kazakhstan officially declares concern about environmental protection and promotes the "polluter pays" principle. Simultaneously, loopholes in the local law allow the discharge of improperly treated industrial wastewater into artificial or natural ponds, which potentially causes fate for environment and society. One example is that permission is based on the requirement that the initial concentration of pollutants in wastewater's recipient is exceeded. Historically, there has been a time gap between when the discharge started and when the monitoring of the recipient started. Thus, the industry receives a legal permit for environmental pollution and does not have any motivation to invest in the improvement of treatment techniques, or into modernization of already obsolete treatment equipment. Moreover, the situation is deteriorated by the facts that industry consumes a huge amount of water, the population is growing, and climate change leads to the reduction of available water resources. Hence, it is projected that the mismanagement of freshwater resources would lead to a national water deficit by 2030. There is only way to improve the situation - rational use of available resources, coupled with assurance of water safety via eliminating pollution. This concept is defined as "Sustainable water use".

This thesis investigates potential consequences of the current system of industrial water use in Kazakhstan based on an example of groundwater pollution, caused by the oil refinery industry. The most basic biological treatment method, activated sludge, which is used by refineries in Kazakhstan, cannot efficiently treat the industrial wastewater. Petroleum hydrocarbons are potentially toxic substances, which are practically ubiquitous in groundwater, usually low degradable, and may move over several km. Analysis of groundwater characteristics surrounding a recipient of effluents from the refinery showed that the groundwater quality has been affected by an unacceptable level of man-made contaminants, which are directly linked to refineries' activity. Rural residents of the studied area use groundwater from the shallow aquifer for drinking and domestic purposes. The current investigation considers the potentially affected sites where to avoid the consumption of unsafe water. The results show that, depending on initial loading, agricultural areas might be affected at a distance 2-6 km downstream the contaminated site.

The situation can be turned on 180 degrees if the pollution stops. Experience from developed countries shows that implementation of advanced wastewater treatment techniques ensures a good quality of the effluents. Moreover, the current trend is

one step ahead – to consider potential wastewater reused, such as alleviation of the stress on freshwater supply, recovery of resources, and elimination of environmental pollution. Also, the current Kazakhstani system of establishing requirements for maximum allowable concentrations of the pollutants in wastewater should be changed and based on the respective investigations of the toxicity of effluents. Specific potentially toxic contaminants are subjected to be controlled in the effluents to get a fair picture of the real harm for groundwater caused by oil refineries in Kazakhstan.

Strong political will is needed to translate concrete actions. This research presented in the thesis is important to show that “zero waste” approach for the industry in Kazakhstan is barely visible and the joint effect of governmental regulation, scientific approach, and industrial implementation can contribute to less impact and the precaution activities for Sustainable water use.