



IMPACT OF THE SEWAGE DISCHARGE FROM HOT SPRINGS TO WATER SOURCES

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Abstract

Hot springs have traditionally been a tourist attraction in many parts of the world, such as Japan, Canada, Taiwan among others. During the peak tourist season, it is usually discharged into streams without treatment, which can affect the quality of the receiving water, causing negative impacts to the aquatic ecosystems. Downstream ecological impacts of several major spa recreational sites in different parts of the world have been studied, and it has been found that wastewater discharges of hot springs have adverse ecological effects. The mineral composition in hot springs, derived mainly from groundwater, is usually greater than that of stream water. Studies carried out with models such as QUAL2K (or Q2K), the modernized version of the QUAL2E (or Q2E), simulate the effect of the hot spring discharges on surface water sources, mainly negative in nature. Despite the negative consequences of the impacts on ecosystems derived from hot springs' wastewater, it is interesting to note that there are regulations for wastewater discharges – including backwash water from swimming pools – into rivers and sewers (e.g., Germany and Canada), but not specifically for hot springs discharge. Nonetheless, this evidence indicates a necessity for the authorities to increase the control of the use of hot springs and the discharge of their untreated waters. In Colombia, Resolution 631 of 2015 regulates the discharge of wastewater into rivers and sewers. Yet, it does not consider parameters for the discharge of hot springs. However, the authors deem

it necessary to advance in the investigation on the contamination of the wastewaters coming from hot springs, and think about a sustainable tourism of hot springs.

Keywords: discharge; hot springs; impact; untreated

Resumen

Las aguas termales han sido tradicionalmente una atracción turística en muchas partes del mundo, como Japón, Canadá, Taiwán, entre otros. Durante la temporada alta de turismo, se suele descargar a arroyos sin tratamiento, lo que puede afectar la calidad del agua receptora, provocando impactos negativos en los ecosistemas acuáticos. Se han estudiado los impactos ecológicos aguas abajo de varios sitios recreativos de spa importantes en diferentes partes del mundo, y se ha encontrado que las descargas de aguas residuales de las aguas termales tienen efectos ecológicos adversos. La composición mineral de las aguas termales, derivada principalmente de las aguas subterráneas, suele ser mayor que la del agua de los arroyos. Estudios realizados con modelos como QUAL2K (o Q2K), la versión modernizada del QUAL2E (o Q2E), simulan el efecto de las descargas de aguas termales en fuentes de agua superficial, principalmente de naturaleza negativa. A pesar de las consecuencias negativas de los impactos en los ecosistemas derivados de las aguas residuales de las fuentes termales, es interesante notar que existen regulaciones para las descargas de aguas residuales, incluidas las aguas de retrolavado de piscinas, en ríos y alcantarillas (por ejemplo, Alemania y Canadá), pero no específicamente para la descarga de aguas termales. Sin embargo, esta evidencia indica la necesidad de que las autoridades aumenten el control del uso de las aguas termales y la descarga de sus aguas no tratadas. En Colombia, la Resolución 631 de 2015 regula la descarga de aguas residuales en ríos y alcantarillados. Sin embargo, no considera parámetros para la descarga de aguas termales. Sin embargo, los autores consideran necesario avanzar en la investigación sobre la contaminación de las aguas residuales provenientes de aguas termales, y pensar en un turismo sustentable de aguas termales.

Palabras clave: alta; aguas termales; impacto; sin tratar

1. Introduction

Tourism can have negative effects on the natural environment, particularly due to increased consumption of water resources, increased amount of waste, emission of pollutants and generation of wastewater (Lenarth et al., 2005).

In case of hot springs tourism during high seasons, thermal wastewater is often discharged into rivers without any treatment, affecting the quality of the receiving source, causing negative impacts on aquatic ecosystems (Yan et al., 2005). Downstream ecological impacts of several major spa recreational sites in different parts of the world have been studied and it has been found that wastewater discharges of hot springs have ecological adverse effects (Taipei Times, 2004). The mineral composition of hot springs derived mainly from groundwater is usually greater than that of



stream water. There are models that simulate the effects of hot spring discharges into surface water sources.

2. Methodology

This study presents a brief description of the impact of the sewage discharge from hot springs to water sources from studies conducted in Taiwan. For this, various references such as international magazines and state of the art books were consulted with the following search criteria: i) discharges of hot springs anthropogenic wastewater; ii) impact of hot springs discharge, and iii) hot springs discharge regulations.

3. Impact of the sewage discharge from hot springs to water sources

The concentrations of some components in hot springs water are higher than those in normal stream water, including potassium K^+ , sodium Na^+ , calcium Ca^{2+} , magnesium Mg^{2+} , sulfate SO_4^{2-} , hydrogen carbonate HCO_3^- , fluoride F^- , chloride Cl^- , silicon dioxide SiO_2 , boric acid HBO_2 , carbon dioxide CO_2 , pH, total dissolved solids (TDS), mercury Hg, arsenic As, antimony Sb, beryllium Be, lithium Li, rubidium Rb and cesium Cs (Yan et al., 2005). Toxic elements, such as arsenic, may be present. Levels of arsenic in water from Meager Creek hot springs, British Columbia, Canada, were found to be naturally elevated (Koch et al, 1999). Yet, the environmental impact of these higher mineral concentrations does not seem to be as significant compared to the anthropogenic impact of the bathers.

In the case study in the Taipei metropolitan area in Taiwan, the QUAL2E (EPA, 2004) model was used to simulate the impact of hot springs sewage discharges in the Nan River - Shin Creek. The results of the model noted that during peak tourism season, untreated bathing water discharges could cause non-compliance with river water quality standards in receiving streams. Thus, showing the mineral composition being less significant, and recommended that the Taiwanese authorities regulate hot spring discharges to protect their aquatic environment (Yan et al., 2005).

The model results show that bathing water from hot springs has a significant adverse impact on stream river water quality during periods of minimum flow. A major factor though, which needs to be taken into account and duly evaluated, is that the hot spring wastewater is estimated to contribute up to 50% of effluents discharged into the receiving water, which may be the principal reason for the significant impact of the hot spring water in this case (RTESE'21, 2021).

Another study for hot spring wastewater in Wulai area, Taiwan, mentions, *"The characteristics of untreated wastewater from hot springs have not been studied in adequate detail. Many studies have focused on diseases, including viruses, bacteria, and phages. Very few, however, have focused on wastewater pollution"* (Lin et al., 2010).

In 2005, the Hot Spring Act was legislated in Taiwan to manage hot spring resources. Similar



regulations are in force in Japan, Korea, and China. There are regulations for wastewater discharges – including backwash water from swimming pools – into rivers and sewers, for example, Germany (Germany, 1997) and Canada (Alberta, 2013), but not specifically an effluent standard for hot spring wastewater. Despite, the presumed negative consequences of the impacts on ecosystems derived from hot springs wastewater. This may be due to generally limited effluent amounts normally discharged into the receiving water, and/or because the significance of hot spring water (mineral) composition itself is little compared to the anthropogenic contamination (RTESE'21, 2021). Deeming the source of the bathing water less important.

Hot spring wastewater is generally discharged directly to the sewer system like in Japan, where the treatment fee for hot spring wastewater is cheaper than that for domestic wastewater. In Europe, United States, China, and Korea, effluent wastewater standards are used and applied to restaurants, hotels, and resorts or recreational companies to control hot spring effluents (Lin et al., 2010).

The United States Environmental Protection Agency has given a special permission for discharge of hot springs wastewater under the national pollutant discharge elimination system in a specific case (EPA, 2018).

Colombia has great hot spring resources, where many of the hot spring spas do not have their wastewater discharges to water sources regulated. Resolution 631 of 2015 regulates the discharge of wastewater into rivers and sewers. However, it does not consider parameters for the discharge of hot springs (Colombia, 2015).

Overall, natural hot springs baths are an important component of health and wellness tourism as well as for recreational use that has become particularly significant in countries with bathing traditions, where sustainable tourism is important. Nevertheless, one of the challenges is the sustainable consumption of hot springs, where the contamination of hot springs must be minimized (Erfurt, 2021; Qi Liu, 2021).

4. Conclusions

It is necessary to advance in the investigation on the contamination of the wastewaters coming from hot springs, where the authorities increase control over the use of hot springs and the discharge of their untreated waters. It is also important to think about a sustainable tourism, where the consumption of hot springs is an important factor. The contamination of hot springs must be minimized by reducing anthropogenic pollution and suitable water treatment.

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