Urban snow and snowmelt runoff inorganic pollution and its impact on the receiving river in the city of Brest, Belarus

Ina Bulskaya[1], Alexander Volchek[2]

[1] Brest State University Named After Pushkin, Brest, Republic of Belarus (inabulskaya@gmail.com)
[2] Brest State Technical University, Brest, Republic of Belarus

1. Introduction

The urban environment differs from the natural and is characterized by significant presence of impervious surfaces and a large number of sources of pollution. Impervious surfaces do not permit rain and snowmelt infiltrate into the soil, forming significant amounts of surface runoff and thus alter natural hydrology. While the rain surface runoff is a common subject of investigation in many countries, the snowmelt urban runoff has been paid little attention to (Buttle et al. 1998). During the winter period (from November to March) in countries with moderately continental climate due to the snow cover presence, not only typical sources of pollution (e.g. litter and rubbish from streets, soil and pavement erosion, vehicle emissions, aerosols and emissions from industry) contribute to surface runoff contamination, but also such factors as winter weather characteristics (periods of snow fall and snow melt, intensity of snow fall, duration of dry periods), road de-icing composites constituents, pattern of street cleaning, salting and snow removal etc.

The aim of this paper is to study snow and snowmelt runoff inorganic constituents on the urbanized territories and to point out components that can present a potential environmental threat. According to this, concentrations of inorganic ions such as chlorides, phosphates, nitrates and ammonium, heavy metals as well as suspended solids (SS) were measured in samples of snow, snow layer and snowmelt runoff.

2. Materials and methods

Three sample points with different functions typical for urbanized territories were chosen in the city of Brest for the evaluation of inorganic pollutants in snow and snowmelt. Samples of snow were taken during the snowfall periods in clean plastic vessels; snow was melted and analyzed during 24 hours. Samples of snow layers were taken at the same points in clean plastic vessels, discarding the very top snow layer, melted and analyzed the same way that the snow samples. The samples of snowmelt effluents were taken in the ends of drainage pipes that carry effluent from target points to the river Muhavets.

SS were measured by the gravimetric method. Chlorides were measured by titrimetric method. Nitrates, phosphates and ammonium were measured by the photometric method. Heavy metals were measured by AAS.

3. Results and discussion

According to the primary results obtained in our study, several components can cause a potential environmental impact. SS and chloride ions are the primary pollutants both in snow from the snow layer and snowmelt. This is due to the de-icing of streets and roads which is accomplished with sand and sodium chloride mixture. Average concentrations of SS and chlorides are several times bigger than national regulation values. Concentrations of SS and chlorides follow the similar variation and most probably depend on the street cleaning and icing pattern.

Ammonium and phosphate ions average concentration in snowmelt runoff also exceed the national regulation levels values. Discharge of the effluent with elevated level of nutrients (e.g. ammonium and phosphates) can contribute to eutrophication effects.

Moreover, suspended solids can absorb pollutants on their surface and then release them after getting to receiving water stream and cause long-term polluting effects.

4. Conclusions

The surface runoff formed during snow melting periods can carry a significant burden of pollutants that can cause long-term environmental effects on water bodies, if the runoff is drained into the water body without treatment. If the drainage system has an old design (with no treatment facility), all pollutants are transported to the receiving waters. In Brest, a significant percent of surface runoff is drained to the Muhavets river which falls into Western Bug, and thus such runoff can contribute to transboundary element transport.

References

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