Flooding of Tashkent city as the natural factor and anthropogenic risk

Nariman Ganievich Mavlyanov

Institute of Hydrogeology end engineering geology "HYDROENGIO", Khodjibaev str.64, Tashkent 700041, Uzbekistan; E-mail:hydrouz@rambler.ru

Abstract: The geological risk of occurrence and development of natural and anthropogenic processes in territory of Tashkent city is estimated. It is demonstrated that flooding is the major risk factor, which is explained with two case studies. Actions for decreasing the geological risk are recommended.

Keywords: geological risk, flooding, antropogenic risk, Tashkent, Uzbekistan.

Introduction

The geological risk is defined by probability of development undesirable natural and anthropogenic processes - the phenomena as a result of activation of the geodynamic processes creating hazard to the population, worsening ecological conditions in city and buildings, promoting premature deterioration and constructions.
The estimation of geological risk of occurrence and development of natural and anthropogenic processes in territory of Tashkent is connected 1) with the study of ecological conditions of the geological environment, its infringements and pollution status, and 2) with the study of kinds of engineering-economic influences to city as a complex.
There are three kinds of engineering-economic influences in the Tashkent territory: areal, linear and local. The areal ones refer to a) vacant city zones, b) zones of multi-storey buildings, c) zones of one-floor buildings with a water pipe and without a water drain, d) industrial zones and e) irrigated zones. The linear engineering-economic influences refer to roads, railways, water supply lines, underground lines, irrigational and networks etc. The local ones refer to separate industrial targets such as warehouse, cleaning constructions etc.

Results

The estimation of an ecological condition of the geological environment in Tashkent based on the characteristics of conditions of basic components and on a degree of geological and geochemical vulnerability.
One of major factors of geological risk in territory of Tashkent is the flooding in the valley of Chirchik river leading to other dangerous processes – slope dawn, building subsidence, disturbance of seismic conditions, erosive and landslide processes.

Scientific paper

The rise of a ground waters table level reduces a blanket of an aeration zone and promotes penetration of polluting substances into deeper parts. The main causes of flooding are 1) the increase of a feed of subsoil waters after reconstruction of irrigation networks and 2) the filtration from channels, water basins, building foundation ditches and water supply lines. The rise of a ground waters table level is considerably influenced also with the decrease of natural drain territories in connection with construction re-planning. It should be stressed that the flooding depends on irregular design of drainage systems too.

Under influence of the listed factors there is a regional change of a feed of subsoil waters on territories of Tashkent and a raise of their level. Underground lines influence formation and development of flooding when they pass in a direction of movement of groundwaters. Small depths of lines arrangements and underground stations (10-15 m) in an active zone promote their direct participation in anthropogenesis processes of pollution of the geological environment.

An example of natural and anthropogenesis processes displayed at rise of groundwater table level within the limits of the high terraces of the valley of Chirchik river are mass deformations of buildings and constructions in SW of city in the area of multi-storey buildings. On 2,5 x 1,5 km^2 tens buildings were exposed to deformations. The analyses of occurrence of an extreme situation (considering the data for last 30 years) have allowed revealing a principal cause of mass deformations of bases of buildings and constructions.

The research site is located on the left bank of the Anhor channel, taking place on a local watershed on the general direction of the groundwater movement. The underground line passes in the same direction, creating local pressure. The underground line was constructed 25 years ago when the groundwater table level was 17-20 m below the surface. Since that time the level has risen to 10-12 m below the surface with an average speed of 32 cm/year, which has resulted in the occurrence of subsidence deformations. The investigation demonstrated that there is a gradual rise of the groundwater table level leading to a weak loess subsidence and mass deformations of buildings and constructions in a pressure zone i.e. the process constantly develops in time and the negative potential restores.

The second example refers to the industrial zone, located within the limits of bottom gravel of the river terraces. An extreme ecological situation was developed in this area due to the quick rise of the groundwater level.

The underground line that crosses the stream movement of subsoil waters below the industrial zone influenced the area. The underground tunnel and station have practically completely blocked the stream. Extrem ecological situation arose that was reflected in pollution with mineral oils and nitrates and in the receipt of toxic gases in the underground station building and tunnel. Due to these conditions the traffic was stopped practically for two years. Results of complex geoecological researches showed that the underground tunnel and station played a role of a barrier and, as a result, polluting substances were congestioned. The chemical composition of groundwaters has been changed, which is typical for stagnation zones. The ground corrosion activity has increased in relation to concrete and metals leading to collapses of the bitumen sheeting of constructions (water began to act through

joints in a tunnel). The concrete destruction has reached such degree that the space between rails was filled with calcite.
The complex actions for the improvement of described conditions were carried out: the warehouse for mineral oils was liquidated, the new drainage system was restored and, the most important, the groundwater level has been decreased to 10 m below the surface.

Discussion and conclusions

Two case studies indicated the necessity to study a degree of stability and pollution of the geological environment. The type of anthropogenesis loadings should be investigated in detail and the consequences should be predicted.

Actions for decreasing the geological risk

The development planes of the Tashkent city are connected with an increase of anthropogenic influences on the geological environment and with an increased geological risk. Consequently, the town planning should take into account a degree of geological risk of certain territory at acceptance of programs for further development and actions for its protection. However, two thinks should be pointed out:

1) there is no precise picture of distribution of dangerous geological processes in the entire territory of the Tashkent city (laws of their development have not been determined yet) and there is no uniform document exactly binding the distribution of the dangerous geological phenomena and the forecast of their dynamics; maps of geological and geochemical risk of territory of Tashkent city in different scale (1:10000, 1:25000 and larger) should be made; without them it is impossible to prepare the development planes;
2) the methodical concept for the geological risk estimation is insufficiently developed; the technique for conducting planning works, including interactions between natural and town-planning elements of the geological environment, should be firstly defined.

It could be summarized that it is necessary to develop optimum methods for conducting civil work in conditions of dense building city and erection of buildings and constructions on weak ground. The analyses of development of flooding processes in Tashkent allow drawing a conclusion, that their development is stimulated with absence or bad quality of a protective drainage. In many cases it is not projected. Groundwater level should be arranged still deeply and the forecast of its changes should be prepared.
In new urban areas the buildings should be locally protected from flooding by drainage. However, in many cases it happened that the drainage system was inefficient because the local drainage was performed on separate sites of construction. For that reason the drainage system was not united and uniform and became closed.

On the bottom terraces of the Chirchik River the significant water inflows in gravels reduce local drainage waters in an operating time of chinks, and in case of switching-off the electric power or failure of separate chinks the level could be quickly restored, which could cause the flooding of the bases of buildings.

In territory of the historical centre of the city the construction of a drainage network represents significant difficulty or it is absolutely not possible. In that case it is necessary to carry out the precautions actions that include a) the changes in water (thermal and drinking) supply networks, b) a construction of accompanying drainages on all underground highways, along collectors and channels, and c) strict normalization of water-submission in the irrigational network.