International Journal of Materials Engineering and Technology

Published Online: October 2013
Available online at http://pphmj.com/journals/ijmet.htm
Volume 10, Number 1, 2013, Pages 1-8

DETERMINATION OF CONCENTRATIONS OF POLLUTANTS IN THE BUILDING CONSTRUCTION

Emmanuel Yamb and François Ngapgue

University of Bamenda
P.O. Box: 8842 Douala
Cameroon
e-mail: yamb_bell@yahoo.fr

University of Dschang
P.O. Box: 134, Cameroon
e-mail: fgapguefcr@gmail.com

Abstract

The construction industry is a major source of pollution, responsible of particulate emissions, more water pollution incidents than any other industry. Water allows migration of pollution. As storm water flows over a construction site, it can pick up pollutants like sediment, debris, and chemicals and transport these to a nearby storm sewer system or directly to a river, lake, or coastal water. Analysis and evaluation of project documentation relative to the construction of treatment plants of surface wastewater show that the calculation determining the weighted average concentration of pollutants is carried out incorrectly. The reason is the lack of a clear method of calculation. The present work provides an improved method of determining the initial concentration of the pollutants and proposes measures to prevent pollution. Some recommendations have been presented to prevent pollution in construction industry.

Received: May 25, 2013; Accepted: June 26, 2013

Keywords and phrases: pollutants, wastewater, sewage treatment, concentration, method of determination.

Introduction

The protection of water bodies from anthropogenic pollution is a major concern at the present stage of development of the technosphere. The construction industry is a major source of pollution, responsible for around 4% of particulate emissions, more water pollution incidents than any other industry. Water allows migration of pollution. Storm water runoff from construction activities can have a significant impact on water quality. As storm water flows over a construction site, it can pick up pollutants like sediment, debris, and chemicals and transport these to a nearby storm sewer system or directly to a river, lake, or coastal water (Figure 1).

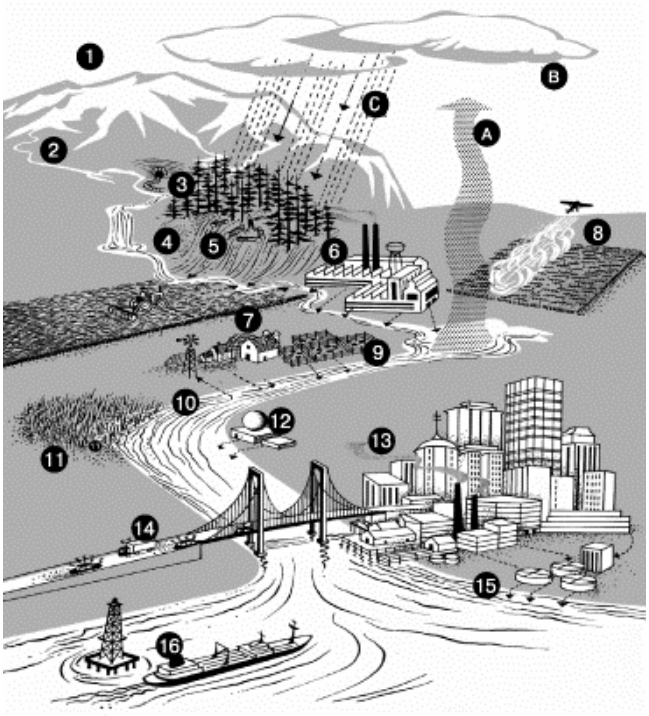

Figure 1. Penetration of pollutants in the water cycle.

Three important stages of the water cycle: evaporation (A), condensation (B) and precipitation (C). If it involves too many natural or man-made pollutants from the following sources, then the natural system is unable to

clean water: 1. Radioactive particles, dust and gases come from the atmosphere along with the snow, drop down and accumulate in the highlands. 2. Glacial melt water with dissolved contaminants flow down from the highlands, forming the headwaters of rivers that are on their way to the sea carry away soil particles and rocks, eroding the surface on which they flow. 3. Water draining mining contains acids and other inorganic substances. 4. Deforestation promotes erosion. Many pollutants are discharged by the paper industry into the river after wood transformation. 5. Storm water wash chemicals from the soil and decaying plants, transport them into the ground water, and washed down the slopes into the river soil and soil particles. 6. Industrial gases into the atmosphere, and from there with the rain or snow - on the ground. Industrial effluents flow directly into the river. Depending on the industry is very different composition of gases and waste waters. 7. Organic insecticides, fungicides, herbicides and fertilizers are dissolved in water, draining agricultural land, to the rivers. 8. Dusting fields with pesticides pollute air and water. 9. Cow manure and other residues of animal origin - major polluters areas with large concentrations of animals in pastures and cattle yards. 10. During pumping of fresh groundwater salinity may occur as a result of tightening their mirror mineralized waters of estuaries and marine basins. 11. Methane is produced by bacteria in natural wetlands, and in standing water in excess of organic pollutants of anthropogenic origin. 12. Thermal pollution of rivers is due to revenues from the power of heated water. 13. Cities are different sources of waste, including both organic and inorganic. 14. The exhaust gases of internal combustion engines - the main sources of air pollution. Hydrocarbons adsorbed moisture in the air. 15. Large objects and particles are removed from municipal wastewater pretreatment plants, organics objects at secondary treatment plants. Impossible to rid out from many substances coming from industrial effluents. 16. Oil spills from offshore oil wells and from tankers pollute the water and the beaches.

The achievement of good indicators in the protection of water resources can be effectively solved in the design phase of treatment plants (Grafkin [1]). At the same time, the analysis of project documentation of more than 10

surface treatment factories of wastewater in compliance with environmental requirements has revealed certain shortcomings in our opinion with the lack of the correct calculation of the initial concentration of pollutants.

The recommendations for calculation of collection, evacuation and treatment of surface runoff from residential areas, industrial areas, and for the determination of their reintroduction conditions into the water supply system is the main regulatory instrument for concentration calculation (VODGEO Research Institute [2]). We can use an average runoff coefficient in the recommendations, which characterizes the total runoff area. At the same time, the total flow area includes different types of catchment surface, with different types of coatings. A real rate of different types of different areas, so the application of an average runoff coefficient yields spaciousness to an incorrect result of calculation.

We propose an advanced method, where the calculation of weighted average concentration recorded annual runoff, which is composed of melting rain, watering and constant flow, depending on the characteristics of the different catchment areas. Constant flow consists of drains and discharges of industrial enterprises, and is accepted on the basis of the data by the method of mathematical modeling.

Essence of the Method

1. We can base ourselves on the landscape plan, which defines the objects captured in the catchment area. The total catchment area F is defined as the sum of squares (F_i) i-x particular catchment number n, which is characterized, above all, by the flow characteristics:

$$F = \sum_{i=1}^{n} F_i. \tag{1}$$

2. We can determine the annual volume W_{A_i} of particular sewage drainage, such a way that a separate calculation in rain W_{R_i}, thawed W_{τ_i} and watering W_{W_i} stock could be expressed as:

$$W_{A_i} = W_{R_i} + W_{T_i} + W_{W_i}, \tag{2}$$

$$W_{D_i} = 10 h_D \Psi_{D_i} F_i, \tag{3}$$

$$W_{\tau_i} = 10 h_T K_y \Psi_{T_i} F_i, \tag{4}$$

$$W_{W_i} = 10 m K \Psi_W F_{M_i}. \tag{5}$$

3. We can determine the annual volume of surface waste water rain, melting, watering runoff from the total drainage area:

$$W_R = \sum_{i=1}^{n} W_{R_i}, \tag{6}$$

$$W_T = \sum_{i=1}^{n} W_{T_i}, \tag{7}$$

$$W_W = \sum_{i=1}^{n} W_{W_i}, \tag{8}$$

$$W_A = W_R + W_T + W_M. \tag{9}$$

4. It is known that for each type of area (SN496-77), we can determine the concentration of surface water contamination. We can determine the mass of each *j*th pollutant contained in each type of flow (rain, melted, watering) for each type of territory:

$$m_{ijR} = W_{R_i} \cdot C_j, \tag{10}$$

$$m_{ijT} = W_{T_i} \cdot C_j, \tag{11}$$

$$m_{ijW} = W_{W_i} \cdot C_j. \tag{12}$$

5. We can determine by the content of the annual *j*th pollutant substances of each type of flow:

$$m_{jR} = \sum_{i=1}^{n} m_{ijR}, \tag{13}$$

$$m_{jT} = \sum_{i=1}^{n} m_{ijT}, \tag{14}$$

$$m_{jW} = \sum_{i=1}^{n} m_{ijW}. \tag{15}$$

6. We can determine the annual average concentration of pollutants for each, thawed and watering drains:

$$C_{jR} = \frac{m_{jR}}{W_R}, \tag{16}$$

$$C_{jT} = \frac{m_{jT}}{W_T}, \tag{17}$$

$$C_{jW} = \frac{m_{jW}}{W_W}. \tag{18}$$

7. We can determine the final initial concentration of the pollutant as follows:

$$C_j = \frac{C_{jR} \cdot W_R + C_{jT} \cdot W_T + C_{jW} \cdot W_W}{W_A}. \tag{19}$$

By this method, we can determine the initial concentration of the three types of pollution: suspended solids, dissolved organic matter (oil), nutrients (nitrogen, phosphorus), as for the other 11 normalized parameters of reservoirs of fish industry destination is not currently determined the typical concentrations for the considered types of surfaces.

The calculation of initial concentrations of suspended substances and petroleum products in the preparation of project documentation of the surface effluent treatment plants for building sites is carried out by different methods. Analysis of various degrees of concentration carried out in 95th District of Mozhajskij in the Moscow region proposes different techniques (Grafkin [3]):

- Initial concentration of suspended particles, which is calculated by the proposed method is 1239.16mg/l and the one of oil products is 21.16mg/l.

- Initial concentration of suspended solids, that is calculated according to [2] is 1141.23mg/l and the one of oil products is 19.67mg/l.

In addition, in accordance with the Recommendations of Research Institute VODGEO for the design of treatment plants for a modern residential

development is proposed to take as the initial concentration of suspended solids the value of 650mg/l and the one for petroleum products is 12mg/l.

Analysis of the results showed that:

- Methodology [2] gives under reporting initial concentration of pollutant treatment plants, which are notable to cleanup to the regulatory indicators;

- The utilisation as the initial concentrations of suspended solids rate of 650mg/l and petroleum products is 12mg/l is also incorrect.

The proposed method allows to obtain more accurate values for the initial concentration of pollutants, followed by the application of which the design of water treatment plants, will ensure compliance with environmental requirements of the proposed facility.

Measures to Prevent Pollution

To achieve regulatory indicators that are to reduce initial concentration of pollutant, it is necessary to adopt adequate measures. Good construction site practice can help to control and prevent pollution. It is indispensable to prepare environmental risk assessments for all construction activities and materials likely to cause pollution. Specific measures can then be taken to mitigate these risks:

1. To prevent erosion and runoff, minimise land disturbance and leave maximum vegetation cover.
2. Control dust through fine water sprays used to dampen down the site.
3. Screen the whole site to stop dust spreading, or alternatively, place fine mesh screening close to the dust source.
4. Cover skips and trucks loaded with construction materials and continually damp down with low levels of water.
5. Cover piles of building materials like cement, sand and other powders, regularly inspect for spillages, and locate them where they will not be washed into waterways or drainage areas.

6. Use non-toxic paints, solvents and other hazardous materials wherever possible.
7. Segregate, tightly cover and monitor toxic substances to prevent spills and possible site contamination.
8. Cover up and protect all drains on site.
9. Collect any wastewater generated from site activities in settlement tanks, screen, discharge the clean water, and dispose of remaining sludge according to environmental regulations.
10. Use low sulphur diesel oil in all vehicle and equipment engines, and incorporate the latest specifications of particulate filters and catalytic converters.

References

[1] M. V. Grafkin, Designing ecological production, MGTU «MAMI» MOSCOW, 2006, 224 p.

[2] Recommendations for calculation system collection, disposal and treatment of surface runoff from residential areas, industrial areas and the conditions of production plants of its waves, Federal State Unitary Enterprise “Research Institute VODGEO”, 2006.

[3] M. V. Grafkin, Method of calculation of concentrations of pollutants in the stage of projection of treatment factories, VESTNIK Journal, Russia 1 (2010), 140-141.

[4] A. Liénard, C. Boutin and D. Esser, Domestic wastewater treatment with emergent hydrophyte beds in France, Constructed Wetlands in Water Pollution Control (Adv. Wat. Pollut. Control n°11), Ed. Cooper P. F. and Findlater B.C. Pergamon Press, UNITED KINGDOM, 1990a, pp. 183-192.

[5] F. Benkhaldoun, S. Daoudi, I. Elmahi and M. Zenasni, Numerical computations of pollutant transport in the Nador lagoon, International Journal of Mathematics and Statistics 8(11) (2011), 1-8.