ASSESSMENT OF THE WATER SYSTEM CAPACITY IS A TOOL OF SUSTAINABLE DEVELOPMENT OF ST.PETERSBURG

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Problem description.

The model of "sustainable development" of the society now recognised world over envisages a compromise between social-economic and environmental interests for present and future generations. Basic conflict between public interests and environmental concerns is that environmental ecosystems and the biosphere already cannot provide for the increasing demands of a man. The environment, however, is not only a resource for the demands that may not exhaust or be polluted but it controls living conditions on the Planet as well. A compromise between economic and environmental interests may be achieved on the condition that the impact stays within the limits of the ecosystems and the biosphere to accumulate antropogenic loads. That's why environmental protection should not be turned to just search for technologies to minimise the pollution.

The main task for today is to assess the capacity of local and regional ecosystems to prevent them from degradation and disintegration. About 70 % of the world's ecosystems that could process almost all the wastes has already disintegrated. In the first place this should be related to water systems acting as extremely important life resource of a man. In St.Petersburg water systems occupy a special place in social and economic development of the city.

Approaches.

Degradation of water systems leads to both health and economical problems. The most clear evidence of an upset ecological balance in a water body meaning the balance between the production of organic substances (accumulation of solar energy in process of photosynthesis) and their destruction (dispersal of energy) is change in the state of eutrophication of the water body. The production-destruction balance may be negative (distrophic water bodies), zero (oligotrophic) and positive (mesotrophic and eutrophic). In presence of excess biological nutrients the speed of photosynthesis is bigger than that of destruction: the water body "blooms" leading to secondary pollution (turbidity, odour, taste, toxins, increase of BOD) and all other types of water use are upset. In absence of biological nutrients or if much polluted with toxicants the speed of production is smaller than that of destruction and processes of water self-treatment are slowed down. In the first case there is eutrophication, in the second - distrophication. Both processes lead to dying of the water body.

Using thousands of sanitary and hygienic maximum admissible concentrations (MAC) of pollutants it is impossible to determine how much pollution the water body can process as the effective MAC protect the health of people and not that of the environment. We offer a different method of determination of loads on water bodies within the limits of their ecological "capacity" that is of ecologically admissible discharges (EAD).

Results.

The Neva Bay in the Eastern part of the Gulf of Finland is the main receiver of waste water in St.Petersburg. Investigations carried out during many years revealed processes of antropogenic eutrophication in the Neva Bay (Fig.1).

Fig.1. Change of trophic condition of the Neva Bay.
П.Т.- integral trophic index

To prevent the ecological balance from upsetting to problems were to be solved.

1. The concentration of pollutants in a water body that won't upset the balance had to be determined. Such concentrations came to be called ecologically admissible (EAC). Unlike sanitary and hygenic MAC they largely depend on regional conditions (climate, hydrodynamics, morphometry etc.). Therefore EAC should be drawn up on regional and for big water bodies on local basis. EAC of biogenic and some other substances were determined for the Neva Base basing on an extensive data base, statistical model and the integral ecosystem condition index. Then the method was used for the Narva Bay in Estonia and Saler Bay in Germany (Table 1).

Table 1.

Biogenic EAC in selected Baltic estuaries.

Water body	EAC, mg/l		
	N min.	P min.	BOD
Neva Bay:			
Northern part	1,3	0,025	2,5
Transit zone	4,0	0,075	5,5
Southern part	1,3	0,020	2,0
Koporskaya Bay	0,15	0,010	-
Narva Gulf	0,12	0,010	-
Saler Gulf	0,09	0,013	-

2. It had to be determined how much biological nutrients could be discharged for the Neva Bay to be able to "process" them and to what extent Nitrogen and Phosphorus should be removed from the waste water. These calculations were made for main waste water treatment plants of St.Petersburg: Northern (NWWTP), Central (CWWTP) and Southern (SWWTP) - under design (Table 2).

Table 2.

Ecologically admissible discharge of Nitrogen and Phosphorus at St.Petersburg waste water treatment plants.

Treatment Plant	AC_{ww}, mg/l	Q_{ww}, mln m^3/d	EAD, t/d	D_a, t/d	Treatment extent, %
	Mineral Phosphorus				
Northern WWTP	0,4	2,0	0,8	5,2	85
Central WWTP	2,7	1,5	4,0	1,0	-
Southern WWTP	0,6	0,5	0,3	1,3	80
	Mineral Nitrogen				
Northern WWTP	16,7	2,0	33,4	26,5	-
Central WWTP	19,1	1,5	28,6	18,4	-

AC_{ww} - admissible concentration in waste water;
Q_{ww} - waste water flow;
EAD - ecologically admissible discharge;
D_a - actual discharge.

Conclusions.

To preserve resource and ecological value of water systems it is necessary to develop methods to assess their capacity at regional level which should not exceed the limits of the water system ability to self-recover. We offer one of possible approaches that was used for St.Petersburg water bodies and can be applied in other regions.

Literature.

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