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METHOD OF EFFICIENT ALLOCATION OF FACILITIES OF THE MUNICIPAL SOLID WASTE SYSTEM ON THE CITY PLAN

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The method of efficient allocation of facilities of the municipal solid waste system lies in justification of the rational methods of designing the quantity and productivity of these facilities, as well as their location. The solution of the task was carried out by means of a comparative analysis of the existing methods and principles for calculating the quantity and productivity of the facilities of the municipal solid waste system. The methods used in this technique are mathematical modeling and geometrical simulation.

The development of the city is a complex harmonious process. The fact is that the city is constantly under the influence of heterogeneous and multidirectional forces. Thus, when planning the development of the city and its engineering systems, it is necessary to consider that the city is a dynamic object: there are constant migration flows in it, a tense ecological state of the urban environment is felt, there is a complex system of spatial connections, and more. The boundaries of cities, traffic intensity, population and building density change over time. All these factors require a review of the basic parameters of the functioning of the city sanitation system.

The unceasing demographic changes that are taking place in the city should be considered in the sanitation. There is an urgent need to transform approaches to planning the development and operation of the municipal solid and liquid waste system in accordance with the needs of a growing population in order to continue to provide services at a comfortable and appropriate level in cities with active urbanization. Therefore, we can confidently assert that one of the most important components of high-quality and comfortable living in a city is the efficient operation of a city sanitation system.

Therefore, already at the stages of design and construction of cities it is necessary to provide for the location of the facilities of the municipal solid waste system. With the further planned development and expansion of the city, the problem of coordinating these processes and coordinating the entire sanitation system of the city with its subsequent expansion arises. With the urbanization and development of the city, the load on the city's sanitation system increases: the amount of municipal solid waste increases, the volume of dewatered sewage sludge increases, the morphological composition of the waste changes. This necessitates an additional amount of equipment for the transportation of solid household waste, containers for collection, the introduction of an additional method of disposal. In turn, the load on the city’s road and transport network increases, which leads to complication of the waste transportation route and, consequently, to the deterioration of the city’s traffic.

One of the ways to solve the problem is to develop a method for locating facilities of the municipal solid waste system based on scientific approaches to determining their rational size, the required satisfactory quantity and their optimal placement on the city plan.

The current situation regarding the location of facilities of the municipal solid waste system and the justification of the locations of collection points is not perfect and does not provide a sufficient level of the environmental safety protection, does not meet town planning and hygiene requirements, and therefore does not allow to build an effective system for collecting solid waste in the city.

In Ukraine, there are regulatory strict town-planning and sanitary-hygienic requirements for the placement of the facilities of the municipal solid waste systemin relation to residential and public buildings and other objects, and these requirements imply the presence of a certain prohibited zone, the boundary of which should be located at a certain distance from the object.

To identify the features of the location of existing facilities, a spatial vector analysis was conducted on a Vinnytsia city plan. The peculiarity of the location of the municipal solid waste systemfacilities consists of regulatory strict town-planning and sanitary-hygienic requirements for the placement of the facilities of the municipal solid waste system in relation to residential and public buildings and other objects, and these requirements imply the presence of a certain prohibited zone, the boundary of which should be located at a certain distance from the object. Within the framework of spatial analysis, they can be conventionally considered as buffer zones relative to objects, a type of vector polygons that limit these objects.

A feature of the proposed method is that the area of permissible locations of facilities of the municipal solid waste system takes into account the varying availability of district objects, the density of its development, the different investment value of land plots, the geometric conditions of non-intersection of zones with prohibition areas (urban planning restrictions) and the conditions of their location in the district; and is built automatically using the mathematical apparatus g.f.d.l. objects, modified in this work, considering the above factors.

We take the area S0 as the initial data for the coverage area.Coverage objects are SI circles (I = 1, ... n) of equal radii.

At the first stage of modeling, we determine the vertex set {Aj} belonging to the convex hull of the area S0. Each of the vertexes {Aj} is the starting point for finding a variant of covering the area S0 (to search for an approximation to local extrema).

At the next stage of modeling, we search through the variants of covering, changing the starting points of the search.

A flow chart of the algorithm for covering an object of protection with circles of the same radius is shown in Figure 1.

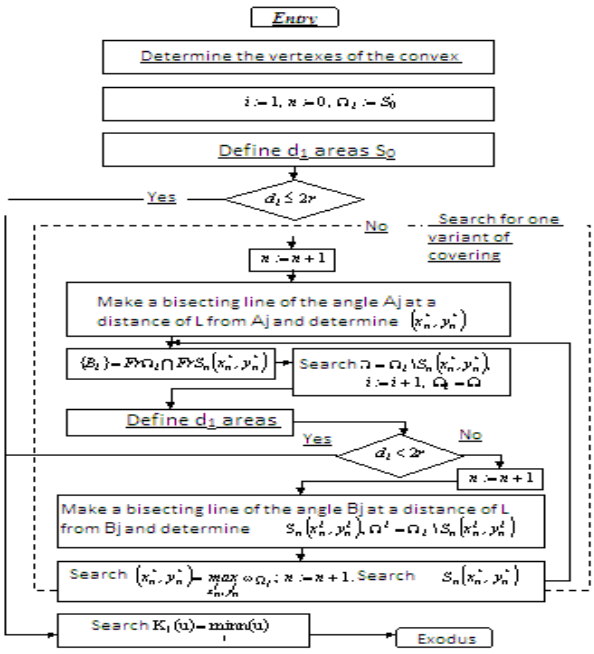

Figure 1. Algorithm

According to the algorithm, a program was created in the C ++ algorithmic language in the Visual C ++ environment, tested by computer simulation on specific examples.

As an example, the city of Vinnytsia was considered (area S_0), and as objects of protection were consideredcircles S_I (I =1,…n) of normalized radius (1 km).The task of full coverage of the area S0 with circles SI with minimization of their quantity was solved.