# RELATIONS BETWEEN INDUSTRIAL AREA PROGRAMMING AND WASTE MANAGEMENT

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## SYNOPSIS

Industrial waste-water management has not yet been given a sufficiently high rank in the programming and planning of industrial and urban regions. Premises for the development of technical infrastructure are, as a rule, treated as a problem of secondary importance and are formulated after decisions regarding location and programming of industrial projects in a given region, have already been made.It is still common practice to design and develop individual parts of the infrastructure treating them as separate problems.Also, their effects on particular elements of the natural environment are investigated in isolation, not in a comprehensive way. Thus, there is a lack of complementariness in the approach to both waste generation, particulary in industry, and elements of the natural environment taken as a whole.

Fig.1 in the paper illustrates the basic relationships affecting the choice of a strategy for industrial wastes management in a region with particular emphasis on the role and influence, needs and pressures from social groups.

A considerable part of the discussion in the paper is devoted to the industrial sludge management, a problem the importance of which is still underestimated.-fig. 2

# RELACIONEZ ENTRE LA PROGRAMACIÓN DE LOS TERRENOS INDUSTRALIZADOS Y LA DISPOSICIÓN DE DESAGUES

Summario

La economia de los desagües industriales no adquirió todavia su rango correspondiente en la programación y planificacion de los terrenos industrializados y urbanizados. Los principios del desarrollo de lossistemas de infraestructura técnica suelen ser elaborados como secundarios, frente a las decisiones concernientes la ubicacion y el programa de la industria en la region. Las particulares ramas de la infraestructura siguen siendo elaboradas separadamente;tampoco hay simultaneidad en determinar su influencia sobre los distintos elementos del medio ambiente. Lo que falta,pues,es la examinación complementaria de las fuentes de los residuos y de varios elementos del medio ambiente considerados como un sistema.

El dibujo no 1 adjuntado al informe presenta las básicas dependencias que determinan la estrategia de la economia de los desagües industriales en la region.Se subraya particularmente la importancia e influencia de las necesidades y presiones sociales.

El informe destaca uno de los problemas minusvalorizados hasta ahora, o sea, la economia de los sedimentos de los residuos industriales el dibujo no 2

# RELATIONS ENTRE PROGRAMMATION DES TERRAINS INDUSTRIELLES ET DISPOSITION DES EAUX USEES

Abréviation

Dans la planification urbaine le problème de l'évacuation des égouts n'a pas encore un rag trop important. Des programmes et des plans du développement de l'infrastructure technique sont établis en principe indépendemment,comme des amiexes qui suivent des programmes ainsi que des décisions de localisation de l'industrie dans la region.

Les differentes branches de l'infrastructure sont étudiées séparement. Les differents types de pollution et leure influence sur l'environnement sont également consideres comme systèmes independents. Par consequent il manque de complexité dans les modelités d'action en ce qui concerne des problemes des source du pollution.

Le schema annexe No 1 explique des relatons les plus importantes qui influencent le choix des regles de l'evacuation des égouts industrielles.Dans ce schema on souligne le role et l'influence des facteurs sociaux dans ce choix.

Dans le document présente on traite souligne aussi le problème d'utilisation du bouqe provenant des egouts industrielles qui est encore sous-estimé - le schema annex No 2

CONCEPTS FOR WASTE MANAGEMENT IN REGIONAL PLANNING

Insufficient knowledge of the relationships between the programming, planning and designing of industrial projects on the one hand and waste-water management on the other is one of the main causes of difficulties encountered in maintaining the required quality of the natural environment.

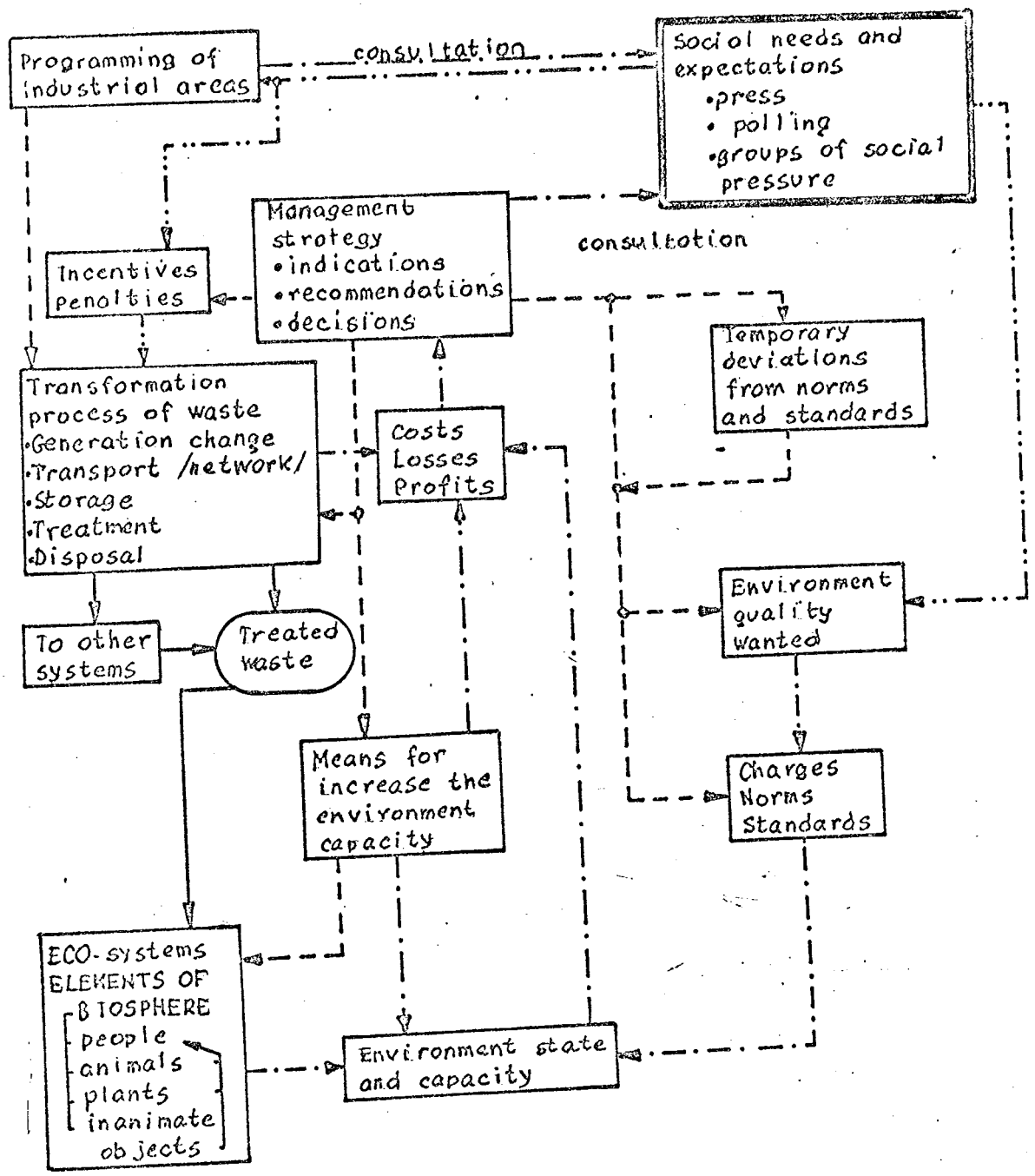
Systems for waste-water disposal and treatment are not only designed after programming and spatial decisions concerning industry have already been taken, but also any subsequent changes in these decisions are frequently made without any regard to the problem of waste-water and-sludge management.

This approach restricts to a considerable degree the probability of selecting the optimum solution from the view-point of waste disposal and environmental protection and breakes the efficient operation of existing systems. Moreover, disregards the inter-dependences linking the development of all the different systems operating in the industrial area and in the whole region.

The concept of wastes management described above has undergone a thorough change in recent years. The motion that "air and water are free" and therefore can be drawn upon without any restrictions is being replaced by the opinion that the assimilative capacity of the environment is finite and that the need to maintain an ecological balance requires a change in the approach to development problems, that is that the town and industry development - to - environment approach must be replaced by the environment - to - town and country planning and industry programming one.

The system of waste materials management presented in Fig.1 is proposed as the first stage in the subsequent choice of a policy for managing differente types of waste in industrial and urban regions. The elements of the system have been treated in a highly integrated manner and therefore require further development of those, that are the object of given investigation. The instrumental criteria of system development are determined in each case by the current and possibilities, namely:
1/ the required degree of detail of the model, 2/ the time available for preparing the model and obtaining results, 3/ the type of available input data, 4/ the organizational structure of the administrative units responsible for the decision or for future operation of the system.

Fig. 1 - WASTE WATER MANAGEMENT STRATEGY FOR INDUSTRIAL AREAS



In relation to the industrial area programming and waste management strategy the following problems should be considered in the greatest detail: 1/ determination of the assimilative capacity of the receiver, 2/ inventory of the sources of wastes generation /existing and foreseen/, 3/ social needs and behaviours that are of decisive importance in the formulation of the preferred line of action, 4/ choice of the methods of treatment and disposal.

Up to now the importance of the last problem has been underestimated in water and waste-water management strategy.

The assimilative capacity of a receiver should be determined on the assumption that there must be no degradation of the ambient environment.*

The assimilative capacity of receiving waters can be increased by: 1/different kinds of technical means, 2/increasing the range of distribution of discharges, 3/reducing the existent degree of degradation of the taken into account elements of the environment, 4/regulating the time pattern of discharges.

T e c h n i c a l  m e a n s include a variety of procedures like augmentation of streamflow, aeration of surface waters, addition of nitrates, and so on.

T h e  r a n g e  o f  d i s t r i b u t i o n of waste discharges, its proper choice, consists in selecting the location and distribution pattern of discharges, i.e. point or non point discharge. As regards distribution patterns, there are two extreme possibilities: 1/ minimizing the range of waste discharge by increasing the waste-load to the technicaly and technologicaly motivated limits, 2/ maximizing the discharge range by setting a maximum discharge area that is practical from the technical and operational points of view. The actual choice of preferred variant is determined by economic and ecological considerations.

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* By degradation of the environment we mean: a relatively permanent reduction of biological activity, deterioration of the quality parameters of ecosystems and plant products, and reduction of the climate-forming, sanitary and landscape-forming qualities of the v getation. Biological activity of the environment is determined by all the biological processes taking place in the water, soil and atmosphere /SIUTA 1977/

The existent degree of degradation of receiving waters can be decreased primarily by eliminating sources of pollution, removing accumulated untreated wastes or resorting to various technological measures aimed at improving the quality of the environment. Identification of factors degrading the environment and assessment of the damage caused by them are of decisive importance in selecting suitable means of immunizing ecosystems and increasing their biological activity.

Regulating the time pattern of waste discharges can compensate the irregularities in the generation of waste-waters and sludges. Specially the shock loads have an adverse impact on sewerage network, treatment plants and receivers. This is specially true for industrial establishments where waste generation is determined by the type of product, production technology, shift work, and so on. For each plant the generation of wastes must be carefully analysed and a time-table of discharges prepared in coordination with all other users of the same receiver. In many cases it is necessary to alter the time pattern of waste discharges and disposal by the use of various storage tanks and other facilities for holding wast@he and sludge until they can be utilized.

Inventory of the sources of wastes generation. Insufficient progress is noted in identifying sources of pollution and ways of its dispersal. Attention is primarily focussed on some point sources while non-point ones and some particular waste are more or less neglected. One of them are sludges, that in various forms and at various phases of treatment are precipitated out of waste waters, either on purpose or unintentionally. For example, unintended precipitation of sludge occurs in sewerage systems and various devices employed in such systems, storage reservoirs and, finally, in receiving waters where sludge forms bottom deposits. Intentional precipitation of differente forms of sludge takes place in various devices used in waste water treatment plants.

The quantity, type and composition of precipitated sludges depend specifically on the characteristic of waste waters, the applied sewage-purification and sludge treatment techniques. However, a comprehensive evaluation of the properties and parameters of waste and sludge in a given region should be based on an inventory of all sources of waste and sludge, as indicated by the regional development plan and industrial area programms.

By making a preliminary inventory of existent sources of pollution and those envisaged in the plan, it is very diffi-

cult, to evaluate their future effect on the environment, propose changes in individual development programmes and indicate locations for industrial areas. One of the most difficult problems that must be solved when programming and designing a waste-water treatment plant is the problem of determining the quantity, composition and discharge irregularity of waste generated in industrial establishments. The reason is that the quality indicators for waste and sludge generated by different industries and future technologies rapidly become out of date.

Ways of influencing the quality and type of generated wastes can be also found in the sphere of social activity. Therefore in regional planning consideration is given to the relationships between social structures and the way of life, needs and behaviours of social groups which result in a variety of pressures on the market followed by changes in the structure and location of industry. This makes forecasting of the volume and type of generated waste and sludge a very difficult task because of the uncertainty in determining the future development of social needs. The development of a region is characterized by many spontaneous processes. Forecasts concerning such processes often prove to be either totally erroneous or only partly true. The degree of uncertainity in forecasting the volume and composition of sludge that will be generated in the future is today greater than ever before because of the rapid technological progress and appearance of new fields of production. Also, we are not able to anticipate the direction of many social reactions and needs. It is very difficult indeed to forecast the conditions for a future balance in the system-technology-environment. This is particulary true of perspective planning, and long-range planning /after 2010 year/. However, the durable character of the technical infrastructure makes it necessary to adopt such a farsighted approach to the problem.

Choice of an optimal solution of waste treatment and disposal should be related to the technology of treatment of all the differente kinds of wastes contributing to the total waste load discharged to the environment. This is particularly true of highly industrialized areas with a high concentration of emission of all kinds of wastes and a limited assimilative-capacity of the environment. Sludges with differente characteristics are generated at differente points of sewage systems and are affected by a variety of factors. The most important factors affecting the quality and quantity of sludge are the following: 1/type and technical design of the sewerage network /combined, separate, industrial, storm water/, 2/type of devices used in the network /rainfall overflow/, torage reservoir, waste-water and sludge pump stations etc/, 3/type of waste treatment plant, technology

and degree of treatment of waste /mechanical, biological, chemical, etc/, 4/applied method of sludge treatment /aerobic and anaerobic digestion, dewatering, coagulation, etc./ and combination of the used methodes.

The still least advanced field are studies of the losses and damages caused by excessive loading of environment and of the benefits resulting from the use of various technical procedures in the transformation and utilization of sludge. High transport costs make it necessary to locate waste treat ent facilities as close as possible to the site of their generation. However, if sludge is to be discharged to the soil then a variety of factors should be considered, such as terrain features and ways of land utilization, soil quality class, ground water level, possible occurrence of insulating layers in the soil, and many other factors, mostly quite independent of industrial area programm. Choice of the methode of sludge utilization is one of the main factors affecting waste water treatment management and has an decisive impact on location of industrial areas.

This is specially true when from the many methodes of sludge utilization /composting, landfill, land application, and reclamation, sale as soil conditioner, ocean disposal, combustion and if needed pasteurization etc/ the utilization of sludge in land is planned.

In recent years much research work has been done in Poland on utilization of sludge in land reclamation in areas where the soil has been degraded as a result of industrial activity/mainly lignite strip mines, construction of large sea-ports, etc./. From the results of such studies it has been possible to determine the optimum amounts of liquid sludge and the correct time of discharge onto the land being reclaimed/. The variants were used in these studies, involving the application of 250 to 500 tons of dry-matter per hectare./

LOCATION OF INDUSTRY AREAS FROM THE VIEW-POINT OF WASTE MANAGEMENT

As far as water supplies and waste-water disposal are concerned, three basic types of industrial locations may be distinguished: 1/industrial plants located within the range of municipal sewerage and/or water supply systems, 2/ plants located beyond the range of municipal systems but discharging waste waters /pre treated or not/ to a regional waste water treatment plant, 3/ plants located beyond the range of municipal sewerage and water systems and operating their own sewerage facilities. It is fairy frequent practice to built combined waste treatment plants serving both municipal and industrial

needs.

The combined treatment is generally considered to be for many reasons the most economical solution. The advantages lie also in the simplicity of administration, operation and control. Particulary in the case of smaller industrial establishments located within, or close to a municipal sewerage system, mixed waste can generally be treated in one plant more efficiently, economically and with greater degree of reliability, than in individual plants. Each case when the establishment is located beyond the range of municipal system, must be at all times carefully analyzed depending the distance of location, the characteristic /quality and quantity/ of industrial waste, indispensable degree of pretreatment, and other local conditions, that is to say the investment, operational and environmental costs must be taken into account. /ROMAN 1970/ .

Although the regulations in force usually specify the standards that must be met by the waste water discharged into municipal sewers /in Poland 39 indications are required/ and the industrial establishments must only pay the rates and take care not to exceed standards specified by the municipal sewerage authorities, these regulations are often violated and the authorities are not able to detect such violations. For example, an engineering or automobile factory might discharge an excessive amount of oil as a result of an unexpected failure of its pretreatment plant.

In a large industrial town in Poland the local sewage treatment plant is now and again put out of operation because of periodic failures of the waste-water neutralization facility in a large viscose rayon factory. The same factory has caused furing the forty years of its operation considerable damage to the municipal sewerage system as a result of the powerful corrosive action of soluble part of calcium sulphate, even in waste-water that have been subjected to proper neutralization. /KOZIOROWSKI 1980/.

The weakest point in the existing waste- management system is undoubtedly the problem of treatment and disposal of sludge. Estimates from various sources put the total volume of sewage-sludge in Poland at approximately 20 - 30 mln $m^3$ a year. Of this approximately 55% is generated in municipal waste treatment plants.

Up to now the control of industrial waste discharges into municipal sewerage systems has concentrated mainly on the protection of vesers and prevention of disturbances in the sewage treatment process. A total elimination of industrial waste

discharges into municipal sewers is neither possible nor necessary. The same can be said of the use of sophisticated pre-treatment methods prior to discharging industrial waste into sewers.

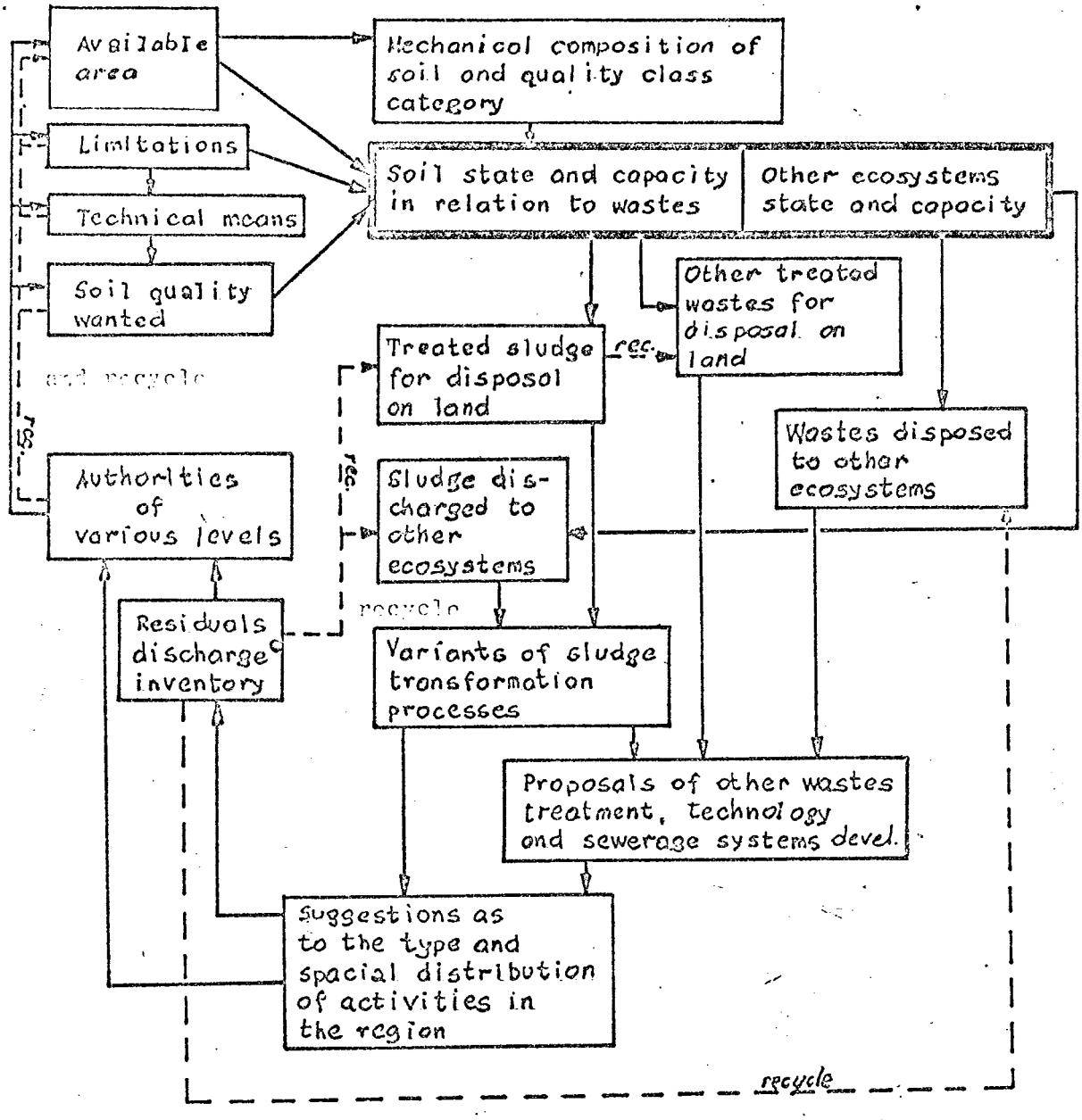
However, potentially useful domestic sludge must not be permitted to became a burden because of pollution with toxic or other harmfull substances from industrial discharges. More stringent control of the content of unwanted substances discharged into municipal sewers will unavoidably increase the volume of concentrated liquid wastes, the disposal of which will have to be handled by the producer. Obviously this requires that adequate provisions be made when programming, planning and designing an industrial project for sufficiently large site on which to build facilities for pre-treatment of waste-waters and treatment of sludge. Also, further expansion of an industrial plant or modification of production technology might be limited as a result of problems with waste-water and sludge treatment and disposal.

Considerable problems are encountered in the disposal of sludge generated in industrial waste treatment plants if the sludge cointains harmful or toxic substances in high concentrations. These include nit only compounds of heave metals, but also sulphide and cyanide anions, oxidising and reducingmagents, detergents, etc. Such sludge increase the total volume of solid wastes generated in the production processes, which are also toxic. Among the latter are wastes generated in chemical plants. An example of this is furnished by the problems encountered in the storage of phosphogypsum, a waste generated in phosphoric fertilizer industry. In one of phosphoric fertilizer factories in Poland, a special plant had to be built to treat the strongly acidic waste-water from the phosphogypsum dump - the liquid waste contains approx. 1 g fluoride ions per $dm^3$.

It is clear from the above that, irrespective of weather an industrial project is to be located within the range of a municipal sewerage network, or will discharge waste-waters into a regional sewage treatment plant, or will have on-site sewerage system and discharge treated waste into receiving waters, the problem of industrial sludge management is an important factor in selecting the location and size of the site and protective zones. In many cases the problem of sludge disposal determines the choice of the sewage management system to be employed in the region and in industrial areas.

With reference to fig. 2, the proposed sequence of steps to be taken in the sludge-management planning procedure is based on estimation of the assimilative capacity of the elements

Fig. 2 - CHOICE OF THE SEWERAGE SLUDGE MANAGEMENT PROCEDURE FOR DISPOSAL ON LAND




o present and forecasted

of the environment. By determining the general balance for consecutive time horizons it is possible to formulate proposals for regional development plans. It is stipulated that the question of sludge treatment and disposal be given more prominence than is the case today in the planning of sewerage systems in industrial areas.

In an attempt to determine the degree of importance that should be given to the problem of sludge management in the general conception of industrial and regional development programmes, the elements and relationships affecting the choice of an optimum system solution have been identified. A solution is considered optimal when the system is capable of protecting particular elements of the environment, treated as a whole, at minimum cost, with the use of the available technical means and in accordance with the accepted social and economic policy.

## COMPLETION

Ways of improving economic and ecological indicators of investment projects are to be found not only in the choise of technologies for waste treatment and disposal, but also in programming and planning industrial areas in relation to other waste sources in the region. Close collaboration of industry, town and country planners, technical infrastructure specialists, ecologists and sociologists which represent the social needs and wishes, administrative and legislative authorities and economists, including step-by-step consultations, should produce considerable economic results and a faster improvement of the quality of life, so expected and wanted everywhere. It is clear from the above that improvement of environmental condition in industrial areas calls for a more holistic approach to the problem.

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