# SECTION 7. CHEMICAL TECHNOLOGIES AND ENGINEERING

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## ENERGY AND RESOURCE-SAVING AEROSOL NANOCATALYSIS TECHNOLOGY

## ЕНЕРГО- ТА РЕСУРСОЗБЕРІГАЮЧА ТЕХНОЛОГІЯ АЕРОЗОЛЬНИЙ НАНОКАТАЛІЗ

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The main environmental problem is the accumulation of garbage dumps in Ukraine and the world. Sweden, Japan and some European countries are already fighting landfills. In this way, they were able to make changes to their ecological lives. These countries have found their own approaches to sorting and recycling waste. This has a positive effect on the implementation of waste recycling in Ukraine. First, there is a need to teach people how to sort garbage. Next, it is necessary to organize the speed of its recycling. It is necessary to invent a technology that will help to do this. This recycling technology must be environmentally; not have additional waste; have useful secondary recycling products. It has been determined that waste contains valuable chemicals. Their processing can provide useful resources.

These resources can be used as raw materials for further transformation or directly as an energy resource.

Let's consider how other countries have managed to organize waste sorting and recycling. In Japan, the concept of waste sorting is established at the state level and every resident perceives it as a duty. Garbage is sorted there into special blocks. There is a separate block for plastic, glass and aluminum bottles. Light bulbs and batteries are separated separately. Newspapers, metal products and accumulators, etc. are separated separately. Waste that can be disposed of using high temperatures (leather, paper, organics) is sorted separately. In France, the use of plastic packaging has been completely banned. Its recycling rate is only 25%. To facilitate sorting, blocks with multi-colored lids are used. Also in France, the secondary use of things is used, especially for those with low wages. Factories have also learned to obtain secondary raw materials. Most waste recycling plants are underground. They are considered environmentally safe. Canada has been teaching its residents to eco-friendliness for over 40 years. Many state programs have been organized to protect the environment. This has helped organize the recycling of up to 50% of garbage. The country also uses multi-colored containers for sorting garbage: plastic, glass, metal, organics, paper, batteries. The country has completely abandoned the use of polyethylene and plastic materials. A clearly formed program has allowed organizing the disposal of large items. If possible, these items are reused. Otherwise, they are taken out as garbage to special landfills. Germany also uses deep sorting of waste. There are three containers: plastic, bags and film; paper materials; organic and food waste in every city and near every house. The country is introducing the recycling of clothes as a charity event. Residents take their own bulky waste to special sites, otherwise they will be fined. The country was able to recreate the economy with the help of the recycling business. In general, the country recycles about 60-80% of its waste. But the problem with the use of plastic materials remains the most important in the country. The environmental problem was most acute in the USA, where up to 11 kg of garbage was thrown out per person every week. The States began to fight garbage with deep sorting; combating the use of disposable plastic materials; collecting used packaging for its recycling according to the experience of other countries. The USA has more garbage recycling plants than in France. About 1,000 enterprises have been created to obtain biofuels by processing organic waste. China is also introducing a system of environmental protection and waste recycling. The country has introduced a fee for garbage collection. They use machines to collect bottles and containers from various waste. They use bonuses for correct waste sorting. The country is constantly searching for and developing the issue of waste recycling. The country has abandoned the import of waste from other countries and is restoring

technologies for secondary raw materials. Italy also has the most important problem with waste recycling. They are constantly fighting the use of disposable plastic packaging. They are organizing the transition to eco-packaging from biodegradable materials. They were able to work out waste recycling, build incinerators and invent their own sorting system only in Sardinia. There are about 40 incinerators in Italy, but they recycle only 18% and 27% of the waste that goes to obtain fertilizers [1].

As we can see, all countries had state assistance in the environmental program. All countries introduced sorting programs and implemented them. Constant search for technologies and planning of waste incineration plants leads to economic effect.

According to statistics, the profit from the use of waste processing complexes for polymeric materials, metals, paper and cardboard, textiles, glass containers can amount to several million UAH. On average, the economic effect can be even more than 1,000 million UAH. Any solid household waste contains valuable secondary raw materials. It is used for further processing, but not completely: paper 26%, food products 40%, wood 4%, textiles 8%, metal 6%, glass 9% and polymers 6% [2].

The problem with waste processing plants and landfills in Ukraine is the most acute. There are very few waste processing plants in Ukraine. Therefore, all the garbage is deposited in landfills. These landfills in Ukraine are located near each of the administrative cities of all regions. They are only growing and occupy even more space. This is the most acute environmental disaster. But it is possible to find a solution for this problem. Based on the experience of other countries, it is possible to invent your own solution if you consider garbage as a resource for obtaining heat or energy.

One of these ways may be the promising technology of aerosol nanocatalysis. This technology was developed by Ukrainian scientists. The studies of chemical transformations at this technology have shown the following [3]:

- increase in the rate of chemical transformation based on the mass of the catalyst in $10^4$-$10^5$;
- decrease in the catalyst concentration 0.3-1.0 g/m$^3$;
- obtaining non-toxic reaction products in exhaust gases; their concentration is at the MPC of the working area;
- solving the problem of heat resistance and density of the catalyst;
- possibility of controlling the catalyst concentration during chemical transformation;
- possibility of using reagents in any state of aggregation;
- use of non-toxic simple metal compounds as a catalyst.

This technology was effective in the neutralization of hazardous pesticides, household waste and paranitrochlorobenzenes, as well as in the

disposal of industrial waste from the chlorine industry. Aerosol nano-catalysis technology may be useful in application for energy purposes. Laboratory and research installations were created according to the principle of this technology. These installations were of stationary and mobile type. One of the options for use can be a combined technological scheme with the production of electrical energy and a steam of technological parameters.

Aerosol nanocatalysis technology also allows solving the problem of oil sludge disposal. These oil sludges are formed during the production, processing and transportation of petroleum products, as well as in case of accidental oil spills. Oil sludges and acid tars occupy large areas and pollute soils and water bodies. They are complex mixtures of petroleum products, water and minerals.

It is known that existing technologies use two conversion options: deep processing and separation of valuable hydrocarbons. The first option provides complete separation of hydrocarbons, but greatly pollutes the atmosphere. The second option makes it possible to return valuable hydrocarbons to the technological cycle, but does not solve the problems of cleaning soils and water parts.

Both of our Ukrainian technologies can help solve the problem of oil sludge. This is the technology of aerosol nanocatalysis [4] and the technology in high-temperature heat carrier [5]. In this case, we use a two-stage technology of waste utilization. The heat from the utilization of the organic part of the waste can be converted into electrical energy, and sulfur oxides from flue gases, for example, can be converted into mineral fertilizers.

Such a combination of technologies makes it possible to carry out many processes of waste disposal or recycling, or the synthesis of chemical substances.

With a reasonable approach to this most pressing environmental problem, there is an opportunity to use it with benefit. The solution may include the problem of landfill accumulation and obtaining useful products or energy. When using aerosol nanocatalysis technology, we also get an environmentally friendly technology.

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