CONTEMPORARY APPROACH TO ANNIMAL BY-PRODUCTS DISPOSAL PROBLEMS

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Abstract: *This work gives basic principles of the contemporary approach to solving of animal by- products disposal according to the rules of European Union, based on contemporary knowledges of science in that domain. The work contains data, explanations and personal views, which are results of many years lasting scientific and professional working and experiences of the authors.*
The significance of safe disposal of animal products was analyzed from epidemiologic, epizoothiologic, environment protection and economic points of view. It was pointed out that contamination of the environment, especially of air and water, can have their origins in the process of removal of died animals, inedible by-products, and in their processing into feeds or raw materials for chemical industry. It was emphasized that objects for animal wastes processing should be treated from the two aspects: as processing plants serving for the environment protection and as possible environment polluters.

Key words: *animal by-products; safe disposal, environment*

INTRODUCTION

Fundamental task of agriculture is the production of adequate quantities of high quality foods and raw materials of organic origin for the existing World's population and for high increasing of that population of about 93 million people per year [Kennedy, 1993]. Even growing demands for food production impose the needs of more efficient managing with economic resources that such one production follows. Management with agricultural resources is crucial for survival of mankind, i.e. for the economic, cultural and social development of the society.

Safe disposal of the inedible animal wastes was treated differently during its long history till up to today, when it obtained an exceptional significance. Today, it is considered as irreplaceable veterinarian-sanitary and preventive measure in suppression of spreading of infective diseases of animals and human beings [Ristić et al., 2003]. Even more and more is emphasized its role in rehabilitation and protection of the environment.

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With respects of realization of this, appears the necessity of organized collection, storaging and disposal of animal by products from slaughtering of animals by their technical processing in specialized plants, which from this raw material obtain (depending on category foreseen in the Directive EU 1774/2002) high-quality animal feed or the raw materials for biofuels production (biogas, biodiesel) with the complete protection of the environment [Ristić et al., 2006; Okanović et al., 2008e].

In order to realize the complexity of this problem, in this work we described the contemporary position and solution of this problematics, what in fact represent the objecttive of this study.

Importance of safe disposal of animal by products

Necessity of solution of safe disposal of animal by products by their utilization with processing into animal feed and bioenergents, grows with the intensification of animal growing and the increasing of capacities of industrial slaughterhouses, uprising of new small slaughterhouses, building of plants for meat processing and increasing of the volume of international trade of commercial animal products [Okanović et al., 2006].

Correct solution of safe disposal of animal by-products can be perceived with three key aspects that should fulfill the technological solutions for solving of disposal of such materials by their processing, namely:

- the epidemiologic-epizoothiologic aspect,
- aspects of environment protection, and
- economic aspect.

a) Epidemiologic-epizoothiologic aspects

Having in mind that animal products (inedible by-products of animal slaughtering, died animals and other wastes from cattle-growing farms) must be treated as potential sources of infective diseases of human beings and animals, their sanitary disposal ought to attach an exceptional significance [Ristić, 1981; Ristić and Kormanjoš, 1991; Ristić et al. 2005, Okanović et al.2008d].

Brana Radenković et al. [1998] and Ristić et al. [2000] in their research articles state that in breeding stocks of animals exist the individuals, which, in spite to the fact that they do not show any clinical signs of diseases, carry in themselves definite pathogens, which they during their life excrete into environment (feces, urine) and after their natural death or slaughtering such carriers can be found in their carcasses or slaughterhouse wastes. At the animals that died because of infective diseases, before their death bacteraemia, vitaemia (salmonellosis, red wind, swine plough and other carriers) were found. Some kinds of microorganisms even in state of agony of animal pervade all parts of the body (*Cl. chonvorei*, *E. coli*, *Cl. perfrigens*), while others only after animal's death penetrate from the digestive system in all parts of the died animal (*Cl. bifermentas*, *Cl. bifoetidum*), contributing to their degradation. Because of that, each died animal and inedible slaughterhouse by-product should be regarded as the highest possible source of infection.

Many carriers which occur in such waste materials can relatively long keep their viabilities, and after that they can in different ways reach into the environment [Ristić et al., 1996 and 2005; Hrgović and Brana Radenković, 1998]. For aerobic bacteria survival in tissues of died animals, conditions are better if animal were not buried, especially if the degradation process runs in the environment with optimal moisture content. Conditions for multiplication of pathogenic anaerobic bacteria (*Cl. septicum*, *Cl. perfrigens*) in dead animal carcasses are also convenient. This is supported by the fact that the botulinous intoxications, which their origin owe to the food poisoning with toxins of the bacterium *Cl. botulini*, types C and D.

Infection can be transmitted on animals and on human beings from the environment by direct contact with animal by-products, first of all with unprocessed or inadequately processed animal products, with food contamination, with air or by mediation of other

vectors (insects, rodents, dogs, wild animals, birds), or on some other way. Under distinct conditions, happen the opposite cases as well – transferring of diseases form people to animals. Such conditions create some kind of the infective circle with moving of infection provokers in the environment between human beings and animals, with or without of distinctive mediator. Some of such contagious diseases are rage, glanders, tularemia, anthrax, scarlet fewer, tuberculosis, salmonellosis, brucellosis, foot and mouth disease, Q-fever, leptospirosis, trichinosis, highly pathogenenous virus of avian influenza –bird flu »H5N1«, pathogenic prion P_RPBSE [Prince et al., 2003].

Exceptionally high danger represent animal that died from the infectious diseases whose carriers are spores, what are the cases with anthrax and the gas edema. Sporogenous forms are very resistant to the environmental factors, so that their survival life is long-lasting. In the moisture soil, according Asaj [1976]) spores of *B. antracis* survive some 6 – 30 years. Carrier of eryspelas keeps its virulence in the buried corpse in average 166 days. Carrier of brucellosis survives in soil some 3 – 4 months. Virus of the atypical plague of poultry survives in corpse 7 weeks, and virus bird flu 3 – 7 days; in the open water courses virus of avian influenza – bird flu keeps alive even 30 days. Tuberculosis carrier in buried bovine lungs was destroyed after 167 days and in intestinal contents after 187 days.

If it is allowed that dogs or wild animals plunder parts of the infected animals, carriers of the diseases can be transferred over larger areas and considerably contaminate soils. In such a way the so-called anthrax - or gas edema districts can be created, representing high and many years lasting dangers for animals of that region, as well as for human health.

Strauch [1972] wrote that from animals on people can be carried over a number of zoonoses (from horses 55, from bovines 50, from swine 46, from dogs 65, from cats 39, from rats and mice 32, from chicken 26 and from wild animals 106 diseases). Among diseases that can be carried over from birds, the author gives ornithose, atypical plague of poultry, Newcastle disease, listeriose, pasterelose and salmonellosis. Vectors for carrying over of zoonoses can be dead animals, by products from slaughtered animals, confiscates, excretions of sick animals.

The same author in his review on dangers of infections of humans that represent residues from cattle feeding production and on prophylactic possibilities emphasizes that the use and disposal of animal wastes represents not only the technological, but, primarily, the hygienic question. That is the question of protection of spreading out of zoonoses and infections, adverse odors and dirt, as well as of endangering of surface - and underground waters with toxic waste waters. At that time, the author especially emphasizes the role of died animal corpses and of slaughterhouse wastes, particularly of those from poultry rising production.

Strauch [1976] indicates dangers that could represent household wastes as carriers of diseases of human beings. That confirms a number of references from professional literature, which state, for example that carriers of typhoid disease are able to survive in the sludge more than 40 days, and of pseudo-dysentery and of black boil (anthrax) even 80 days.

According to Bosiljka Đuričić [1997] and Ristić et al. [2005], number of the recognized zoonoses in the World is high (about 180), and we are witnesses of the appearing of some new ones, which until today were not registered as zoonoses (lime-boreliose, Ebola hemorrhagic fever, ehrlichiosis and from the year 2005 officially the bird flu as well). From the registered zoonoses, according to Bosiljka Đuričić et al. [1998], 34 are diseases with bacterial etiology, 56 are viral diseases, 10 of them cause *Rickettsiales* and *Chlamydiales*, 13 are mycoses, 57 are diseases of parasite infections, 5 diseases cause arthropods, and for 4 diseases carriers are prions.

In recent years global epizoothiologic and epidemiologic situation with respect of communicable diseases and zoonoses has been considerably changed. That was in-

fluenced, of course, by definite number of facts, such as rapid development of communications, accelerated development of technology and raw material exchange, inadequate utilization of animal wastes, wars, economic crises and other.

According to the World Health Organization data, momentous epizoothiologic – epidemiologic situation in the World indicate to the fact that high number of communicable diseases show trends of expansion, so that with justification can be said that mankind's future belongs to communicable diseases that day by day take their tribute on distinct parts of the World. From medical, veterinary, economic and environmental points of view, the highest significance have enthosia, whose sources are linked with locations in nature, the so-caller natural-seated infections. For following of their outspreading and undertaking the eradication measures a lot of specialists with different professional profiles are needed, and their work on the eradication is painstaking and long-lasting [Bosiljka Đuričić and Brana Radenković, 1997; Bosiljka Đuričić et al., 1998]. Examples of the complexities of eradication of zoonoses in our country can be seen in eradications of brucellosis, rage, tularemia, trichinosis [Teodorović et al., 1997; Ristić et al., 2000], Q-fever and other zoonoses.

Cited data confirm that animal by-products from epizoothiologic and epidemiologic points of view represent high dangers with respect of animal and human health, what necessitates needs for rapid and efficient, and at the same time, safe disposal of the mentioned materials.

b) Aspects of the environment protection

Today is even more and more attention paid on the protection and upgrading of human environment, because it is threaded with creation and accumulation of waste materials. The country strives to produce highest possible quantities of material properties that should satisfy human's needs for the best possible standard of living and to create optimal conditions for maintaining of sanitary conditions. Nevertheless, together with welfare properties that are necessary to human being, modern technical civilization creates high quantities of waste, which exert negative effects on the environment, degrading it to such degree that it becomes harmful for health of people and of animals [Ristić 2000; Okanović et al., 2008a].

Polluters are numerous inorganic and organic substances that reach in an organism with contaminated air, water and before of all, food. Their quantities are small, but in the course of time, they accumulate in individual tissues and organs, causing diseases, degeneration or even death of organisms.

It seems that together with aspirations for something better can have opposite consequences. This is fully applicable on agricultural and cattle growing production, which survive many changes. Such one tendency is enabled with industrial preparing of feeds and with even higher automation and mechanization of cattle growing [Okanović et al., 2007]. With the strengthening of production process in cattle growing and production of even higher quantities of meat, emerges the problem of died animals as well as of heaping up of slaughterhouse wastes [Ristić, 1978, 1981; Ristić and Marinković, 1979; Stojsavljević et al., 1998]. Dead animals, and inedible slaughterhouse by-products, as waste materials created in the production process, must be safe disposed, or, otherwise, they can become a serious brake for further development of production, in this case of food, and as such, they are serious polluters of the environment. On the other hand, they can so severely contaminate the environment, that it begins to hinder intellectual and operative capabilities of human beings and disables the possibilities for their recreation [Tasić et al., 2008].

Died animals [Košmerl et al., 1989; Ristić et al., 1996, 1998] and inedible by-products of slaughterhouses, like, by the way, all organic substances, are susceptible to very rapid degradation. Such one process is accompanied with creation of products of decay, mainly of gases (ammonia, hydrogen sulphide, mercaptans), but also of other products of decay, such as fatty acids, aromatic

acids and other substances [Knop, 1975; Jelić et al., 1980].

Animal wastes and inedible by-products during putrification contaminate not only the atmosphere with stinky and toxic gases, but also the terrain, food and water. Ristić [1981] in his article quoted that the greatest part of blood terminates in the sewage, i.e. in waste water, and that only small share of blood is collected and processed. This is how water courses are physically polluted, and at the same time, in such environments, blood appears as nutrient for microorganisms, many of which are strains pathogenic for human beings and for the animal kingdom. Biological oxygen demand of blood, according Baras et al. [1991], is about 100,000 mgO_2/L. In the year 1982, contamination of water courses with waste blood in SFR of Yugoslavia was about $57 \cdot 10^9$, what corresponds to the pollution caused by about 1 million of inhabitants.

Pollution of the environment with animal wastes shows other adverse effects as well. It is known that sites where accumulations of organic materials and their degradation appears, by the rule are places where swarms of flies gather. Such places are, also, locations with ideal conditions for development of other insects and rodents. They enable spreading of infections and substantially contribute to degradation of visual acceptance of environment in which they live. Inadequate handling of died animals and by-products of farms and slaughterhouses also leads to contamination of soils, surface and underground waters, foods and different objects, making them inconvenient or less valuable for use [Ristić 1981, 2000, 2007; Okanović et al., 2008b].

Aesthetic unacceptability of so threaten environment is one of the problems that deserve even more space and time.

The environment, especially air and water, can be contaminated even in the process of safe disposal of died animals and of inedible by-products of slaughtered animals and their processing into feed and raw materials for chemical industry. Because of that „the objects for animal wastes processing“ (according to Ristić et al. [1998; 2005]) should be considered from two points of view – as objects serving for environment protection, i.e. as manufacturing plants and, at the same time, as the environment polluters.

Polluters from the process of safe disposal of these by products are:

- scattered inlet raw materials,
- waste waters,
- waste gases,
- organic dust, and
- contaminated solids not adequate for processing.

Problems create noises and vibrations from processing plants, as well. Scattered input raw materials in the object for safe disposal of animal wastes by their processing, if they were not removed on time, can be the significant sources of environment pollution and they can complicate normal technological process in the factory. Owing to the activities of microorganisms, i.e. of their proteolytic enzymes, scattered raw materials are decomposed, with spreading of infections and generation of degradation products, mainly of stinky gases (ammonia, hydrogen sulphide, mercaptans), as well as of fatty acids and aromatic acids [Knop, 1975; Ristić et al., 1987, 2005, 2006].

In regular technological process, in the reception - and manufacturing (final) part of the object, organic material is disintegrated by microbiological or thermal processes, with generation of ammonia, hydrogen sulphide, sulfur dioxide, carbon dioxide, carbon monoxide, hexane, heptane, octane, decane, methyl-penthane, methyl-hexane, dimethyl-hexane, propane-triol, toluene, trimethyl-amine, acroleine, aldehydes and ketones [Jelić et al., 1980; Kralj, 1984; Ristić et al., 1987; 1998]. Kinds and quantities of gasses that appear depend on raw material kind, handling of raw material and the applied technology of its processing [Ristić et al., 1994; 2005].

Prevention of pollution of the environment with the undesired harmful gasses and dust

demands their forced leading away from rooms of reception and processing parts, as well as from the corresponding equipment into the object for their purification and deodorization.

Waste waters in factories for processing of animal wastes appear in reception part, processing (final) part and in the station for cleaning and disinfection of transport vehicles [Ristić et al., 1987; 1997; 1998]. Quantities and characteristics of waste waters, according the data given by Jelić et al. [1989], Ristić and Kormanjoš, [1984; 1996] and Ristić et al. [2005] depend on kind and quality of input raw materials and the applied technological procedure of their processing. Waste water obtained in reception part must be collected and sterilized using thermal or chemical processes and, together with other waste waters transferred into separate object for waste water treatment.

With respect to the fact that objects for animal wastes processing ought to fulfill two basic functions – to protect the environment from pollution with animal wastes and to generate sanitary correct products, it is obvious, during the designing of the object and during its regular operation, as well as during the unwanted incidents, to implement regular measures for protection of the environment. The protection primarily, implies unharmful disposal of polluters that are generated in objects for animal wastes processing [Ristić and Okanović, 2008].

All above-mentioned indicates that the so far used methods of disposal of died animals and of inedible by-products, in spite of all advancements, suffers from many problems with the absence of unique solutions, so that in this domain today, at the beginning of 21st Century, we still find a mosaic of procedures known from relatively long history of disposal of this kind of organic materials. It is understandable that such a situation does not satisfy contemporary needs, either from aspects of suppressing of cattle contagion, or in connection with the improvement and intensefication of animal growing and the environment protection [Ristić et al., 2007; Okanović et al., 2008d].

Disrespecting of the rules on safe disposal of polluters reflects on soil-, atmosphere-, surface- and underground water qualities in the neighborhood, i.e. on climate and, further, on plant- and animal kingdoms and on health of human beings or, definitely on the eco-system as the whole.

c) Economic aspect of disposal of dead animals and inedible by-products obtained from slaughtered animals

Economic side of this problem implies collection and safe disposal of huge quantities of biological materials that necessitate costs, which have to be incorporated in prices of the obtained products. If wastes of animal origin were not processed (recycled), they represent lost raw material that was possible to incorporate in production of proteinaceous - energetic feed, technical fat for chemical industry or of fuels with high calorific value [Okanović et al., 2008].

According to the European Union directives included in the Regulation (EC) N^{o} 1774/-2002, with processing of sanitary safe inedible by-products obtained during slaughterrring of animals (materials Category 3), it is possible to obtain:

- proteinaceous, protein-mineral and energetic products aimed for animal feeding,
- technical fats,
- feathers for textile industry,
- skins, horns, hoofs, hairs,

and from died animals (materials Category 2):

- meat-and bone meal as an energent,
- technical fat as an energent or raw material for further processing in chemical industry of for production of bio-diesel, and
- biogas, compost.

Safe disposal of the described animal wastes (material Category 1) by combustion on high temperatures (over 850°C) enables obtaining of warm water or steam as an energent for processing plant that use warm water or

steam, and ash as construction material for roads.

We shall mention only that with the respecting procedures of blood collection and its technological processing various articles for human use can be obtained, primarily products, which are used as functional additives in manufacturing of meat products. Special processing procedures enable their use as raw materials in pharmaceutical industry or for production of functional foods [Matekalo-Sverak et al. 2007, Tasić et al., 2008].

On the other hand, industrial waste blood can be collected and processed using corresponding technological procedure in a plant for processing of other animal by-products, using special processing unit. Such one procedure enables obtaining of feed with high protein content, which, mostly, contains high quantities of essential amino acids, vitamins and mineral substances, and particularly iron [Okanović et al., 2008f, Ristić et al., 2008].

Articles (meat- and bone meal and fat) obtained by processing of materials of Category 1 are suitable for use as energetic fuel, i.e. as fuel for direct combustion in architecturally separated objects, respecting the corresponding legislative rules.

If all cited aspects were treated correctly, it is clear that organized processing and disposal of unharmful inedible slaughterhouse by-products obtained from slaughtered or died animals is of great importance for prevention of spreading out of contagious diseases, successful protection and rehabilitation of the environment and for rational usage of such wastes.

Methods of rehabilitation of animal wastes

Each period of economic development and of scientific cognition in human and veterinary medicine leaves its contribution in understanding and solving problems of safe disposal of animal wastes. Regardless of historical period, basic aim of the activities in this domain was to achieve rapid degradation of organic substances and to inactivate eventually present infective organisms, with, at the same time, prevention of contacts of human beings with the contagious materials. It was realized in different manners:

- burying on animal graveyards,
- throwing of died animals into pits-repositories,
- combustion in special furnaces, and
- technical processing.

Changes in the modes of rehabilitation, according to Jovanović and Bosiljka Đurić [1998], and Ristić and Jovanović [2001], happened with the appearance of neurodegenerative diseases of animals and human beings that characterize spongiform degeneration of brain – diagnostified as spongiform encephalopathy of bovine animals, i.e. the BSE, whose carrier, as it was found in the year 1986, is feed containing inadequately produced meat-and bone meal obtained from ruminants (as stated in the Regulative of European Parliament on ine-dible animal by-products – Regulative (EC) N^{o} 1774/2002).

According to the contemporary regulations in the European Union, animal wastes can be safely disposed, depending on their category, with the following methods:

1. burying on graveyards for pets,
   - burying on locations where organizing of other methods of safe disposal is hardly practicable because of the inaccessibility or for some other reason,
   - burying at the place of outbreaks when just described contagious diseases happen,
2. incineration of raw wastes in special furnaces on high temperatures (850 – 1200°C),
3. combustion or co-combustion, after technical processing in the plant, which fulfills conditions for such method of safe disposal,
4. processing with production of compost and biogas, and
5. thermal processing into feed.

Prerequisites for choice of some of the allowable methods of safe disposal that corres-

ponds for our region lie in recognizing of basic characteristics of different utilization methods.

Burying belongs to the oldest methods of safe disposal of died animals, which does not fully achieve the goal of the fastest possible extermination in contagious materials, because decay processes of organic substances in the ground are relatively slow, depending also on the ground quality. According to Ostertag et al. [1978], Ristić [1981], Ristić et al. [2000] and many other authors, burying of died animals and inedible by-products obtained from slaughtered animals represents insanitary and uneconomical method of their safe disposal. The existing data on resistance of carriers of contagious diseases in decaying materials clearly indicate that burying of corpses of animals that died in consequence of contagious diseases, is not any kind of safe disposal, and that it represents conservation of contagious diseases carriers for the period of more decades. Burying of corpses, as a method of disposal can be, according to the cited authors, be tolerated only as emergency exit in the case when do not exist possibilities of applying thermal methods because of inapproachability of terrain, as well as for corpses of small animals (pig, lamb, dog, cat, rabbit and similar). There exists objective danger, if dead animals were buried improperly, so that the contagious material can be transferred with underground water on the neighboring region. Because of that, Scientific committee of European Union, on the basis of previous and recent investigations, prescribed that only dead pet animals can be buried, on orderly arranged graveyards for pets or, of dead animal is not heavier than 50 kgs, the owner can bury it on his property, 2.5 meters from border with neighboring property, and in inhabited settlement 20 meters from the neighboring building (with exception of spaces where difference of levels of surface and underground water does not exceed maximal value of 1 meter). Well constructed graveyard for pets represents satisfactory mode of safe disposal for urban settlements, where appear significant numbers of pet animals.

Combustion of died animals and inedible raw slaughterhouse by-products represent safe, but the most cost-effective method of safe disposal on the infected materials [Ristić et al., 2005].

Co-combustion (co-incineration) of animal by-products (materials belonging to Category 1) and of products obtained from by-products of processing of materials of Category 2 – meat and bone meal, is the safest and economically justified method of safe disposal of dangerous animal wastes.

Safe disposal of animal wastes with their processing and production of biogas represents one of alternative methods for safe disposal of categories 2 and 3 materials. This method of safe disposal of animal wastes is relatively cost-effective, because it necessitates thermal processing of animal wastes, i.e. the corresponding infrastructure for biogas production with complicated technological process of bio-fermentation and biogas production.

According to Ristić et al., [1996; 2000; 2005], without any doubt, the newest and the best method of safe disposal of animal wastes is their technical processing in separate categories into products for chemical industry, bio-fuels and feed for definite kinds of animals.

Prerequisite for safe disposal of animal wastes using one of the described methods is organized collection and delivery of raw materials. Modern disposal of waste materials demands orderly constructed plants with adequate capacities, which should assure permanent and continuous supply of raw materials. This confirms the importance of recognizing of the raw materials fundaments for each object, i.e. organizing of epizoothiologically and economically acceptable region, which should enable obtaining of adequate quantities of animal wastes that should allow designing and construction of modern object for their safe disposal [Savković et al., 2007].

Exceptionally important is to emphasize the necessity of transferring of animal wastes from the place where they were generated to the storaging place as fast as possible, as well as the necessity of rapid performing of the procedure of their processing. This is very significant, not only from the epidemiologic-epizoothiologic aspect or from environment

protection aspects, but equally from the aspect of their technical processing. Namely, fresh raw materials are processed easier, with generation of lower quantities of waste gases and obtaining of better quality products.

In such collecting circle, organizing of collection of animal wastes represents very delicious problem, from whose solution to a very high degree depends the successful operation of the plant that is going to process such raw materials. This problem in any case has to bother both plant that process raw materials of animal origin or cattle growing farms and slaughterhouses that generate such raw materials. Also, important role in solving of the problem have local municipal communities. They are, according the existing legislative rules on suppression of contagious diseases, obliged to organize safe disposal of animal wastes in their region. In other words, organization of collecting of mentioned raw materials should be based on contractual linking of plants for safe disposal and processing of animal wastes and local municipal communities or their corresponding organizations (slaughterhouses, animal farms etc.).

The acceptation of safe disposal of animal wastes for their processing and incineration excludes classical forms of disposal (holes, animal graveyards), except for exceptional occasions, so that localities for such objects, nevertheless should be foreseen. It is valuable to add to this that, in the most cases, not solved question of training of participants in such activities, their inadequate numbers or inadequate qualifications, or insufficient equipping with the corresponding vehicles for transportation of dangerous things, further complicate the problem [Ristić et al., 2000, 2004].

CONCLUSION

Agricultural and food industry by-products, if not valorized, are disposed on landfills, in lagoons, buried in arid terrains or in open water courses, thus contaminating the environment.

Keeping up with laws and regulations, measures on safe disposal of polluters must be strictly complied, to protect qualities of soils, air, surface and underground waters, plant and animal kingdoms, as well as the health of human beings.

To the most rational solutions of their disposal belong their processing into feed, or raw materials for chemical industry and production of biofuels. Manufacturing of feed from sanitary safe raw materials (animal by-products belonging to Category 3 products) they are multiply valorized, with assurement of the rational development of cattle growing and of protection of the environment.

Application of biofuels contributes to reduction of oil consumption (i.e. of imports), reduction of emissions of detrimental gases, stimulation of sustainable development of rural regions and increasing of available quantities of high-quality animal feed.

If all mentioned ecological and economical aspects are recognized properly, it becomes clear that organized solving of safe disposal of inedible by-products obtained from slaughtered or died animals by their technical processing is a valuable task. This contributes to prevention of spreading of contagious diseases, to prevention and rehabilitation of the environment and to rational use of waste materials.

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