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MARKETING COMPONENT OF RESOURCE-SAVING ENVIRONMENTAL TECHNOLOGIES OF FALLEN LEAVES UTILIZATION

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The article is devoted to the formation of marketing-mix elements for resource-saving ecological technologies of fallen leaves utilization that basis on technological process analysis. There is no doubt about statement that fallen leaves are beautiful. However, the romance of autumn leaves charms everyone, except those people, which forced to clean it up. In situation when people got a lot of trees and bushes on the garden, they need to clean leaves as fast as possible in order not to damage the grass cover. Every year utility workers and gardeners go to "battlefield", several times raking tons of fallen leaves and piles of leaves that also serves as shelter for small animals and promotes for saving and reproduction of microorganisms. Meanwhile dissolution of the leaves emits methane gas, which is more than 20 times more destructive that CO_2. Despite the ban and big fines, people continue to burn leaves piles, guided by habit and reluctance to spend on the payment of removal. Considered that fallen leaves should be disposed of as organic fertilizer and processed as organic fuel. A fundamental review of the existing waste disposal and recycling technologies was carried out leaves. Author offering a solution about resource-saving eco-technology of the disposal fallen leaves and gives his opinion about the prospect of further development of existing progressing technologies, exception is obtaining biogas. Also explained the tendency of consider them as interesting technical solution that has been tested, for example creating a resource-saving eco-technology for the disposal of fallen leaves. Resource-saving eco-technology and equipment that works autonomously for bio recycling and heat recycling of leaves which fallen is proposed for consideration. That helps you to avoid many problems such as design-technological and organizational-logistic. Technology doesn't require operations of grinding, washing, re-grinding and pressing, which makes it unnecessary to involve the most difficult mechanisms and devices which isn`t cheap. That equipment has no heating system, which makes insignificant values of indicators of combustion, heat generation, content of harmful impurities; thermobriquettes are transportable which excludes the ingress of moisture and oxygen. Also, cross terrain vehicle can`t transport leaves or biomass, it doesn't increase fuel consumption during heavy traffic.

Keywords: fallen leaves, useful properties, properties saving, autonomous equipment.

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Introduction

Fallen leaves [1-6] are beautiful. However, the romance of autumn leaves charms everyone (Fig. 1a), except those people, which forced to clean it up. In situation when people got a lot of trees and bushes on the garden, they need to clean leaves as fast as possible in order not to damage the grass cover. Every year utility workers and gardeners go to "battlefield", several times raking tons of fallen leaves and piles of leaves that also serves as shelter for small animals and promotes for saving and reproduction of microorganisms. Meanwhile dissolution of the

a **b** **c**

Fig. 1. A typical relation to fallen leaves, where: romantic beauty (a. [1]), ecological disaster (b. [2]) and lost benefit (c. [1])

leaves emits methane gas, which is more than 20 times more destructive that CO_2.

People guided by habit and reluctance to pay for removal continue to burn leafy piles (Fig. 1b), despite the ban and significant fines. This act is according by "smoke show" with persistent bitter smoke and dust emissions that also gets on clothes and respiratory tract.

While 100 kg plant residues are burning, about 1 kg of smoke micro-parts enter the air, which contain: dust, nitrogen oxide, pesticides, radionuclides, heavy metals, a number of carcinogenic compounds and almost 0,3 kg of carbon monoxide, which blocks the supply of oxygen to body tissues.

Benzolyrene can cause cancer and dioxins. There are released from smoldering leaves without access to oxygen. And there are almost poisonous substances too. At the same time leaves which a lot of garden owner junk usually burns, it significantly increases air pollution. Polymer bags and bottles add about 70 harmful compounds to the "autumn smoke".

Fallen leaves can be used as organic fertilizer and fuel [6-12]. In 3...4 years, it will completely rot and turn into a homogeneous mass – called humus (Fig. 1c). That it can be used to fertilize plants both in the open ground and added to pots with indoor plants or boxes with seedling. It is troublesome, but in the conditions of a small homestead it can be expedient. Air in cities, can be polluted by emissions from, factories, cars and buses. People have to deal with leaves in a slightly different way. Green leaves, act role of sponge, absorb all harmful emissions, and fallen leaves return all these harmful substances to the soil, poisoning it. In cities, fallen leaves have to be collected, transported to a landfill or to an enter price for processing into fuel cells. When they are burned, ash remains, which can be used as valuable fertilizer that containing useful components:15-20%of potassium, 6-0% calcium, 5% phosphorus, as well as iron, magnesium, sulfur and zinc. Ash can be used to fertilize not only trees, but also vegetable gardens.

Purpose of the article

Formation of marketing-mix elements for resource-saving ecological technologies of fallen leaves utilization that basis on technological process analysis is the purpose of the article.

Presentation of main material

In our country municipal workers mostly the collecting falling leaves with rakes (Fig. 1a) like ordinary garbage than take it to landfills which overflowing. Meanwhile municipal workers in developed countries more responsible and using modern approach, starting with the involvement of powerful and mobile vacuum cleaners for collecting fallen leaves (Fig. 1b).

Which are effective for collecting fallen leaves from hard coatings and lawn or gravel tracks. Thanks for the mulching function, vacuum cleaners grinding fallen leaves into a homogeneous mass, their density about 5 to 15 times higher that whole leaves got. Chopped biomass is delivered to place of processing or disposal [1]. Of course, it is much better than loading a dump truck, but landfills or processing plants are usually located far from the city. Perhaps, it will be more economical to process the fallen leaves directly at the place of collection and further use of the product by an autonomous disposer. That also applies the received fertilizer.

In the EU countries, falling leaves, bushes, dry grass and other plant biomass collected by sanitary cleaning of parks, streets or house owners processed into high-quality organic fertilizer. Its used to feed the same parks, streets or householders [2]. Plant residues are inextricably linked with a microbiological component consisting of a wide range of bacteria,

a b

Fig. 2. Typical means of collecting fallen leaves, manual (a. [1]) or halfmechanized (b. [1])

microscopic fungi and their by-products. Every natural process accompanies the decomposition of matter, which causes certain difficulties in transportation, storage and burning. Even after 4...5 months of storage, the biomass was seeded with fungal spores, of which about 55 strains were found. Contamination of raw materials with microscopic fungi or their metabolites can cause respiratory, intestinal, and nervous diseases in humans when using products made from plant raw materials [8-11]. But how dangerous situations, when harmful elements and organisms accumulated during the season in fallen leaves migrate to the soil from fertilizer during dissolved or to the air from briquettes while them burning. Maybe, looking for safe and quick means of decontamination of leaves will be advisable.

Leaves that have been left in the garden, soil or landfill gradually decompose with the release of methane into the atmosphere, with causes a greenhouse effect 20 times more actively than carbon dioxide is. At the same time, burning fallen leaves in boilers or furnaces with sufficient access to oxygen, no more than the amount of carbon that was absorbed by the plant during the last summer enters the atmosphere [8, 9]. It seems only in the case is about collection and burning. But under the mandatory condition of supplying a sufficient amount of oxygen to the combustion zone of thermal equipment, fallen leaves make less damage to the surrounding environment.

As we all know, leaves, grass and etc. aren"t best material for burning in boilers, because of high content of potassium and chlorine in them causes slagging of the heat exchange surfaces of the boiler equipment and rapid corrosion. And the ash content exceeds all permissible indicators of DIN EN 14961-6. Ash content reaches 30% in leafy elements. The reason for the high ash content of the leaves lies in high content of sand, earth and various dust, which requires and additional operation of complex washing, and accordingly the presence of water communications and complex equipment. Before and after intensive washing, the leaves are crushed, process isn"t effective with ordinary shredders – special shredder are required, and some moisture is squeezed out mechanically. Sand, solid impurities, dust up to 90% of potassium and chlorine compounds, up to 50% of sulfur and nitrogen are washed out of the biomass, and crushing is eliminated. In addition to water, displaced liquid contains a significant amount of various nutrients (salts), which should be used as fertilizer [7-11]. The problem of solid impurities is solved. But what to do with organic impurities during burning leaf briquettes.

Residue of dust, small particles, hidden bacteria and mold in briquettes is a can be sign of breathing hazard, low mechanical strength and rapid wear. This indicator is important during transportation, storage and supply of briquettes to the boiler for burning, as it can be the cause of losses loading and unloading operations, decrease their mass. In addition, during combustion in small boilers, the supply of oxygen and thus can lead to decrease in boiler efficiency and even make damage to expensive equipment. Distribution of energy costs in the production of leaves briquettes can be as follows: grinding up to 16%, drying up to 70%, compaction up to 17%. Accordingly, a typical scheme for the production of fuel elements from fallen leaves, such as "Leaf Log" briquettes (Fig. 3, a), involves the following operations: collection and transportation of fallen leaves or shredded biomass, washing and additional grinding of biomass (fractional composition – up to 1 sm), pressing and drying (optimal moisture content of bio-raw materials is about 8...12%), mixing with a binding material (30% wax), compaction with shaping and packaging [7-11].

a **b**

Fig. 3. General view of typical fuel briquettes from fallen leaves, where the binding material is 30% wax (a) [10] and 20% lignin (b) [11]

One of the main structural and technological problems of fuel briquettes are next: need to preserve the integrity and suitability of the product, which is significantly affected by the level of moisture and the presence of oxygen during storage (Fig. 3b).

By absence of hermetic packing, the surface is "heated", providing somewhat great stability, but it doesn't resistance to mechanical destruction – the fragile briquette isn't able to ensure uniform combustion. The additional involvement of the binding material, apart from the fact that it increases the cost and complexity of the project, also it doesn't solve the problem of preserving the binding properties when the briquettes enter the furnace. Natural or synthetic polymers are mainly used as a binding material, which is due to the desire to increase the calorific value of the briquettes. As a result, briquettes quickly lose their shape and burn rapidly in the furnace also releasing into the air, as stated above in the introduction to article, an additional 70 harmful compounds [11-15].

On the basis of the above review, according to the authors, restrained attitude towards the further development of the existing processing technologies, with the exception of obtaining biogas [1], is formed, and they are inclined to consider them as interesting tried and tested technical solutions for creation of a resource-saving ecotechnology for the utilization of fallen leaves according to the following list of individual provisions of the initial requirements:

1. An experimental sample of autonomous equipment for eco-technological disposal of fallen leaves, which is intended for installation on the chassis of all-terrain vehicles capable of operating in conditions of covered roads and off road on soils with low carrying capacity. Type of climatic performance of UL according to DSTU 15150.

2. The goal and purpose of the development is creating a pilot sample of resource saving autonomous equipment for the eco technological disposal of fallen leaves, which ensures the mechanized execution of operations from full cycle of disposal, also packing of production on collect place.

3. Main parts driving mechanisms of the prototype from the power take-off shaft of the all-terrain vehicle, which provides for the assembly/ disassembly of autonomous equipment using resource saving eco technology into two various: bio-recycling and thermo-recycling without fundamental changing design and primary purpose.

4. The eco-technological scheme of biological utilization is about mechanized collection and loading of fallen leaves, cleaning them from organic impurities, formation of bio briquettes and slow cooling (seedling container containing only useful inorganic impurities), fermentation and packaging.

5. The eco-technological scheme hear utilization is about mechanized collection and loading of fallen leaves, perforation to form thermobriquettes and intensive burning forced air supply, cooling of ash (fertilizer containing only useful inorganic impurities), then spraying and packing if it"s necessary.

6. The eco-technological scheme provides possibility of alternate, as needed, involvement of certain mechanisms of resource-saving autonomous equipment during bio recycling and thermal recycling, which allows expanding commercial opportunities and more carefully coordinating the volume of fallen leaves and additional materials needs.

7. An all-terrain vehicle provides exceptional logistical advantages, as it allows to preform work regardless of the day time, the vagaries of the weather and the topography of the work area. Instead of transporting, chopped biomass or fallen leaves are going to landfill on high terrain tires, which have

significant rolling resistance and fuel consumptions, transporting will stand and idle with minimal fuel consumption.

Conclusions

By means of a comparative analysis of technological processes of the utilization of fallen leaves, it is proved that the most effective is resource-saving ecotechnology and autonomous equipment for biological and thermal utilization of fallen leaves which allows avoiding many structural, technological, organizational and logistical problems, as it provides the best technical performance. The following advantages of the technology have been highlighted:

– firstly, technology doesn't require grinding, washing, re-grinding and pressing operations, which makes it unnecessary to involve the most difficult and expensive mechanisms and devices;

– secondly, an equipment isn't heating system, which makes the values of combustion indicators, heat generation, the connect of harmful impurities not important;

– thirdly, biobricket is not sensitive to moisture content, which makes its internal contents digested and free of harmful impurities before planning seedlings;

– fourthly, thermo-briquette isn't sensitive for transporting, that makes content of moisture and oxygen not important;

– fifthly, an all-terrain vehicle doesn't transport leaves or biomass, which makes increased fuel consumption during heavy traffic not important.

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МАРКЕТИНГОВА СКЛАДОВА РЕСУРСОЗБЕРІГАЮЧИХ ЕКОЛОГІЧНИХ ТЕХНОЛОГІЙ УТИЛІЗАЦІЇ ОПАЛОГО ЛИСТЯ

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Статтю присвячено формуванню елементів комплексу маркетингу для ресурсозберігаючих екологічних технологій утилізації опалого листя на основі аналізу технологічного процесу. Опале листя – це, звісно, красиво. Проте романтика осіннього листя чарує всіх, крім тих, хто вимушений його прибирати. Якщо на ділянці багато кущів і дерев потрібно вчасно, аби не пошкодити трав'яний покрив, звільнити газон від опалого листя. Щороку комунальники та садівники виходять на «поле бою», кілька разів згрібаючи тонни опалого листя до куч – власноруч створюючи місце зимового затишку не тільки мілких тварин, а й збереження та розмноження багатьох шкідників. Продовж розчинення листяні кучі виділяють газ метан, який понад 20 разів більш руйнівний до навколишнього середовища, ніж CO_2. Незважаючи на заборону та значні штрафи, люди продовжують палити листяні кучі, керуючись звичкою та небажанням витрачатися на оплату вивозу. Але вважається, що опале листя доцільно утилізувати, як органічне добриво та переробити, як органічне паливо. Здійснено принциповий огляд існуючих технологій утилізації та перероблення опалого листя. На думку авторів роботи, складається стримане відношення до перспективи подальшого розвитку саме існуючих технологій перероблення, за винятком одержання біогазу, та пояснюється схильність розглядати їх у якості цікавих відпрацьованих технічних рішень при створенні ресурсозберігаючої екотехнології утилізації опалого листя. Основними результатами статті є розглянута ресурсозберігаюча екотехнологія та автономне обладнання біоутилізації і термоутилізації опалого листя, що дозволяє уникнути багатьох конструкційно-технологічних та організаційно-логістичних проблем, оскільки: технологія не потребує операцій подрібнення, миття, повторного подрібнення та пресування, що робить непотрібним залучення найбільш важких та затратних механізмів і приладів; обладнання не є опалювальною системою, що робить не важливими значення показників горіння, теплоутворення, вмісту шкідливих домішок; біобрикет не є чутким до вмісту вологи, щодо висадження розсади робить його внутрішній вміст перетравленим та без шкідливих домішок...; термобрикет не є чутким до транспортування, що робить не важливими вміст у ньому вологи та кисню; всюдихідний транспортний засіб не транспортує листя чи біомасу, що робить не важливим підвищені витрати пального при навантаженому русі.

Ключові слова: опале листя, корисні властивості, економія ресурсів, автономне обладнання.

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