THE EFFICIENCY EVALUATION OF USING RICE HUSK AS OIL SORBENT

Abdibattayeva M. M.¹; Nurymova R. D.²; Ospanova G. Sh.³; Sansyzbayeva A. B.⁴

¹D. t. s., Associate Professor, KazNU after al-Farabi, Almaty;
²c. agr. s., KSU after Korkyt ata, Kyzylorda;
³master of the geographic science, ENU after L.N. Gumilev, Astana;
⁴master of the geographic science, ENU after L.N. Gumilev, Astana

Аннотация: This article is devoted to research the efficiency of the vegetal sorbents use to treat the oil polluted soils and to purify water from the oil products. As a sorbent the rice husk has been used, which is many tons waste, and that pollutes the environment. In the laboratory to produce this compost we have broken the cellulose-lignin structure of the husk with the help of soil aerobic and anaerobic bacteria, we have done the experiments to evaluate the influence of rice husk as a polluted soil filler as the result of which we have come to the conclusion that the rice husk, creating airspace in the soil, promotes intense oxidation of the oil products by the air oxygen and then their degradation.

Key words: oil sorbent, rice husk, sorption capacity, oil capacity

Oil spill at its production, and also accident rate of the systems of piping, railway and automobile shipping of oil and oil pipelines sharpen the problem of the environment protection.

To the list of emergency situations one should refer oil spill elimination.

Oil and its components spilling into environment, either air, water or soil, cause change of their physical, chemical, biological properties and characteristics and breaks the natural biochemical processes going.

The problem complexity is not only in its measure but also in the criteria development and methods of struggle with this complicated and unsteady by its content pollution. Oil is a complicated complex of substances that consists of 3000 ingredients each of which has an individual solubility and biodegradation.

Spreading of oil pollution on the soil surface leads to the damage of soil structure, nitrogen regime, worsening of soil water permeability, plant cover degradation and also the productivity of farm lands decrease.

Nowadays one of the top modern tasks to protect the environment is searching high-efficient oil and oil products sorbents.

The requirements to the sorbents development are:
- the efficiency;
- the value of relative sorption;
- the ecological purity.
The transport costs to ship raw material, processing, utilization and disposal costs, ecological safety of the used sorbents processing leads to the conclusion that at present it is profitable to use sorbents of vegetal origin.

At sorbents production to absorb oil and oil products as raw materials one can use buckwheat and sunflower, rice and oats husk, and corn kernels, and cane straw and also black walnuts shells, etc.

Using all these materials that are potential local raw material to sorbent produce allows combining elimination of the agricultural wastes with environmental protection.

Oil absorbing capacity of vegetal waste is the main criterion that must be taken into account at producing of this or that sorbent type because the oil capacity of the produced sorbent is directly dependent on the primary oil capacity of pure raw material.

Table 1 – The nutritious content of rice straw by 1ha-kg

<table>
<thead>
<tr>
<th>Nutritious elements</th>
<th>Straw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>1477</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>21</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>5,9</td>
</tr>
<tr>
<td>Potassium</td>
<td>57,8</td>
</tr>
<tr>
<td>Calcium</td>
<td>10,3</td>
</tr>
</tbody>
</table>

The oil absorbing capacity of vegetal raw material is given on picture - 1, [1]. In table - 2, [2] is shown the data by the oil absorbing capacity of some sorbents after their special processing.
The oil absorbing capacity of vegetal materials

The vegetal wastes

Tillage of the oil polluted soil with vegetal wastes
Table 2 - The oil absorbing capacity of vegetal materials after special processing

<table>
<thead>
<tr>
<th>Material</th>
<th>Absorbing capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetal wastes</td>
<td>4-6,5</td>
</tr>
<tr>
<td>Sawdust</td>
<td>4,5-8,5</td>
</tr>
<tr>
<td>Corn wastes</td>
<td>5-7</td>
</tr>
<tr>
<td>Sunflower wastes</td>
<td>6-8</td>
</tr>
<tr>
<td>Rice husk</td>
<td>6-10</td>
</tr>
</tbody>
</table>

Another of the main factors that characterize the sorbents quality is water absorbing picture - 3, [3].

Absorbing moisture by this or that degree the vegetal sorbents increase their weight and as the result their buoyancy worsens as well as oil capacity because part of their threshold space is taken by the water phase.

Kyzylorda region is well known by its developed rice produce that in its turn is a source of annual many tons waste of the rice husk that pollutes the environment.

Being a silicium organic polymer of vegetal origin, rice husk doesn’t burn and rot and also due to its cheap cost it is an irrepleacable source to get biocompost which is needed for the oil products biodegradation.

In the laboratory to produce this compost we have broken the cellulose-lignin structure of the husk with the help of soil aerobic and anaerobic bacteria, we have done the experiments to evaluate the influence of rice husk as a polluted soil filler as the result of which we have come to the conclusion that the rice husk, creating airspace in the soil, promotes intense oxidation of the oil products by the air oxygen and then their degradation.

In order to define the possibilities of the oil polluted water treatment with the help of the rice husk sorbents we have studied their sorption characteristics in the dynamic conditions:
- the degree of oil desorption that characterizes oil return into the production cycle and possibility of its repeated use;
- oil capacity;
- water absorption;
- buoyancy.

It is known that the sorption capacity of the studied materials depend on the oil viscosity: if oil is light, low-viscous ($v = 3.27 \ \text{cCT at } 20^\circ\text{C}$), then the full sorption capacity of the rice husk is 4.9.

If oil is heavy, high-viscous ($J = 186, \ \text{cCT}$), then the sorption capacity of the rice husk is 8.8.

By the mechanic extraction depending on the oil type and sorbent properties it is possible to return into the produce cycle (table 4).

The rice husk (oil 1 61,612 %).

Regeneration by the chemical way is not economically reasonable because it demands the costs of reagents that also will become a problem of further recycling the produced wastes. That is why the thermal sorbent recycling with the residual oil content is very interesting.

After the thermal processing at 500 $^\circ\text{C}$ at the limited air access about 20 % of the sorbents evaporate.

1. After total purification of the sorbents from oil the farther research of the sorbents use have been done by their main properties (sorption capacity, buoyancy and water absorption) [4].

2.

Table 3 – The basic characteristics of rice husk

<table>
<thead>
<tr>
<th>Sorbent type</th>
<th>Sorption capacity %</th>
<th>Water absorption, %</th>
<th>Buoyancy,%</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH Oil 1</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>RH Oil 2</td>
<td>4.3</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Studying the carbonized rice husk we have observed damage of its structure at the oil separation that leads to its buoyance and sorption reduce.

After the repeated sorbent use the extraction of the absorbed oil has been done. The oil seepage has been 40-44.2%.

Table 4 – Oil seepage

<table>
<thead>
<tr>
<th>Sorbent</th>
<th>Oil seepage,%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice husk</td>
<td>Oil-1</td>
</tr>
<tr>
<td></td>
<td>Rice husk</td>
</tr>
<tr>
<td></td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>44.2%</td>
</tr>
</tbody>
</table>

We can see from the table that the less the sorption capacity of oil is, the less its return into the produce cycle.
Defining the possibility to clean the waste water from oil and oil products the research has shown that depending on the speed of passing the being purified solution through the stable adsorbent layer and oil concentration in the being purified water, the sorbents capacity increases.

Pic. 4 – The degree of water purifying from the oil products depending on the passing speed

Pic. 5 – Dependence of the water purifying degree on the oil concentration

Being a product of the vegetal waste recycle, by the purifying degree the sorbent on the basis of the rice husk provides a high degree of water purification from the oil products.

One should also note another advantage: the sorbent has a little amount of impurity, has high content of oxygen and that is why by its structure is close to the active charcoal and its derived structure of the silicon dioxide adds to its firmness and thermal stability.

Hence, high sorption characteristics of the sorbent on the basis of the rice husk is no worse the analogical sorption values on the active charcoals and they provide efficiency of deep post-treatment of high-concentrated solutions of the oil products.

It is also known that oil and oil products sorption by different sorbents much depends not only upon the sorbent density and oil viscosity but also upon the time of the time saturation [5].

Table 5 – Sorption sorbents capacity by the oil of different viscosity

<table>
<thead>
<tr>
<th>Sorbent name</th>
<th>Sorption capacity, ψ/г</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 minutes</td>
</tr>
<tr>
<td>Rice husk</td>
<td>3.0</td>
</tr>
</tbody>
</table>
As we can see, the sorption capacity with time of saturation increases and stabilizes at 100-120 minutes and that is why it is necessary to take into consideration the saturation time as well.

**Conclusion**

Nowadays it is profitable to use sorbents of vegetal origin. To make sorbents to absorb oil and oil products it is possible to use rice husk as raw material. The rice husk has been used as filler of the polluted soil as the result of which the rice husk, creating the air space in the soil, promotes intense oil products oxidation by the air oxygen and then their degradation.

The husk provides high degree of water purification from the oil products. The received sorbent has little amount of impurity and that is why it is close by its structure to the active charcoals, and the derived structure of the silicon dioxide adds to their firmness and thermal stability. It has been studied the sorption processes going in the system sorbent-oil (oil product) – water and influence on them of the number of factors (oil viscosity, oil layer density, sorption length, etc.). It has been proved that increase of the oil layer increases the sorbent oil absorbing capacity, reduces or stabilizes its water sorption and the highest degree of the water treatment from oil is got by the rice husk sorbent (up to 99%). The sorption capacity of the sorbent received from the rice husk is very high and it provides efficiency of deep post treatment of highly concentrated oil products solutions. The received sorbent from the rice husk is ecologically pure and harmless.

**REFERENCES**

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