

RESEARCH ON COOKING OIL ABSORBENT PADS USING WATER HYACINTH MATERIALS

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Abstract

Cooking oil is an indispensable ingredient in everyday family cooking. The oil after use is often discharged directly into wastewater systems, leading to risks of environmental pollution, water pollution, clogging of drainage systems... In recent years, water hyacinth plants have been considered weeds, floating on rivers, canals, ponds and lakes, obstructing the circulation of boats and preventing water flow. Water hyacinth plants are often found in large rivers and almost no one cares about their uses, making them truly wasteful.

Realizing the flexibility of water hyacinth when dried, it can be woven into pieces with good absorbent properties, our team has researched using water hyacinth as a material to absorb used cooking oil that is discarded into the environment. school. The research uses the main methods of experimental method and sample analysis method in its research. The result is that a product that absorbs discarded cooking oil scum is formed and is tested for cooking oil contaminated water with results consistent with QCVN 14:2008/BTNMT. The purpose of the research is to find effective products to absorb discarded cooking oil to save costs and contribute to environmental protection. The problem of using naturally available materials to create products that absorb cooking oil scum at the same time solves two current environmental problems. The research is a preliminary result, so there are still many shortcomings. We hope that in the future there will be further research to make the product more and more perfect

Keywords: discarded cooking oil, environment, experiment, water hyacinth, water pollution

1. Introduction

Water hyacinth is an aquatic plant present throughout the canal network because it has a very fast growth rate. After one month of growth, the initial planted area of 1000m² can be increased from 2300 to 6200m² (Dellarossa and et al., 2001). Water hyacinth grows and develops in a fairly wide temperature range of 10-40°C, but grows best at 20-30°C. With such rapid development, water hyacinth is causing many environmental problems such as obstructing river flow, clogging transportation routes, affecting traffic, and reducing the growth of food. Other aquatic organisms and can release large amounts of nutrients when they die and decay. Besides, the density of water hyacinth also limits the ability to catch fish, affecting water pumping for purposes such as drinking, irrigation, power generation, and biodiversity (Aweke, 1993). Water hyacinth is notorious for causing serious environmental degradation and is an economic burden that needs to be managed. In addition, the water hyacinth has the ability to strongly absorb nutrients and other chemicals from its habitat, and the chemical composition of water hyacinth depends on habitat characteristics (Carina and Cecilia, 2007). Water hyacinth contains chemical ingredients such as: Water 92.3%, Cellulose 1.4%, Lipid 0.3%,

Protein 0.8%, Total minerals 1.4, Non-protein derivatives 5.08%. (Ngo Ke Suong et al., 1997). Water hyacinth in its natural form contains a fairly high water content of 90-95% of its body weight. That's why it is necessary to dry it. Because the water hyacinth content when dried is low, it is the main limit for harvesting, processing and absorbing oil 3 to 9 times the weight of fresh water hyacinth. When dried, water hyacinth is often flexible and soft, and water hyacinth fiber has about 60% cellulose - a carbohydrate compound, so it is easy to weave into pieces with good water absorption ability. Water hyacinth is a type of aquatic plant that grows quickly in environments near water, stagnant water or nutrient-rich water. The water hyacinth grows and develops in a fairly wide temperature range of 10-40°C, but develops best at 20-30°C. According to statistics from the Ministry of Agriculture and Rural Development, the area of water hyacinth in Vietnam is estimated at about 100,000 hectares, concentrated mainly in the Mekong Delta, Central and Northern provinces. Water hyacinth grows quickly, can reach a height of 3-4m, takes up water surface area, obstructs water transportation, and causes environmental pollution. To treat water hyacinth, localities often use measures such as: pulling, burning, plowing, scooping up the shore, etc. However, these measures are often expensive, ineffective and cause environmental pollution. Schools. According to estimates, the amount of water hyacinth discarded annually in Vietnam is about 10 million tons. If this amount of water hyacinth is not handled properly, it will pollute the environment, affecting human and animal health.

Used waste oil will undergo chemical changes due to exposure to high temperatures, air and food debris. The composition of used cooking oil can vary depending on the type of oil and how long it has been used. Normally, the main components of used cooking oil include (Fatty acids, free fatty acids (FFA), oxidation products, polymerization agents). Waste cooking oil is one of the main causes of water pollution. When you pour waste cooking oil down the drain or sink, it will accumulate in the drainage system and form plaque. These plaques will clog pipes, causing flooding and wastewater overflow. It can also enter groundwater sources, contaminating drinking water.

In the world, there have been many experiments to research and use water hyacinth as it can be mixed with bottom sludge from wastewater treatment ponds or with animal manure to produce gas and organic fertilizer (Dobelmann, 1998)... Besides, it is also dried and turned into dry powder to make organic fertilizer, or used to improve soil (Srivastava and Dhar, 1988), and can also be burned into ash to use as a fertilizer. (Adeoye et al., 2001; Sarwar and et al., 1989). There are other studies such as water hyacinth that have been tested to produce protein powder from water hyacinth leaves, which has the potential to become a good source of protein for the food or feed industry in some countries. Area with strong growth of water hyacinth (Virabalin et al., 1993). Specifically, there have been a number of studies evaluating water hyacinth as a food source for livestock (Dey et al., 1983), or have considered incorporating water hyacinth into tilapia feed (Edwards et al., 1985).

Meanwhile, in Vietnam there has not been much research related to water hyacinth, mainly using water hyacinth as a source of raw materials for handicrafts. Mainly in the southern provinces, they only cut and use water hyacinth stems as materials for handicrafts. The remaining leaves and roots are thrown back into the environment. This not only does not limit the growth of water hyacinth, but on the contrary, it also pollutes and wastes available natural resources. In the country, there have been a number of experiments on water hyacinth, such as the method of silencing water hyacinth as a nutritious food source for livestock. This study evaluates the potential of using water hyacinth as animal feed and shows that water hyacinth can be used as feed for livestock, poultry and fish. Besides, water hyacinth also has the ability to treat dissolved nitrogen and organic phosphorus pollution in catfish pond wastewater (Khoi et al., 2012).

2. Material and methods

2.1. The method of data collection

Proceed to collect and research documents through books, newspapers and previous research articles available on the Internet about water samples with cooking oil scum before treatment and after treatment. Research articles have content related to products made from water hyacinth materials. The methods and processes of making the product as well as the advantages and disadvantages of the product.

2.2. Experimental methods for products from water hyacinth

TABLE 1. Statistics of raw materials

Number	Ingredient - Material	Quantity	Unit
1	Wet water hyacinth	10	Kilogram
2	Toothpick	1	Package
3	Scissors	1	Piece
4	Zinc wire	1	Metre
5	Medical gloves	1	Package
6	Face mask	1	Box
7	Measuring cup 100ml	2	Piece
9	Brass	1	Piece
10	Tape measure	1	Piece
11	Bottle PE	2	Bottle
12	Weigh	1	Piece
13	Funnel	1	Piece

To recycle water hyacinth into a complete oil absorbent pad, the following materials are needed:

Materials: To make a complete water hyacinth oil absorbent pad, the materials used are specifically listed as follows:

Implementation process:

The main raw materials used are collected from the Saigon River along Bach Dang Street, Thu Dau Mot City, Binh Duong Province.

Implementation time: 5 hours/ 2 pieces of product (not including time to collect water hyacinth)

Group members proceed to make products according to the following process and materials:

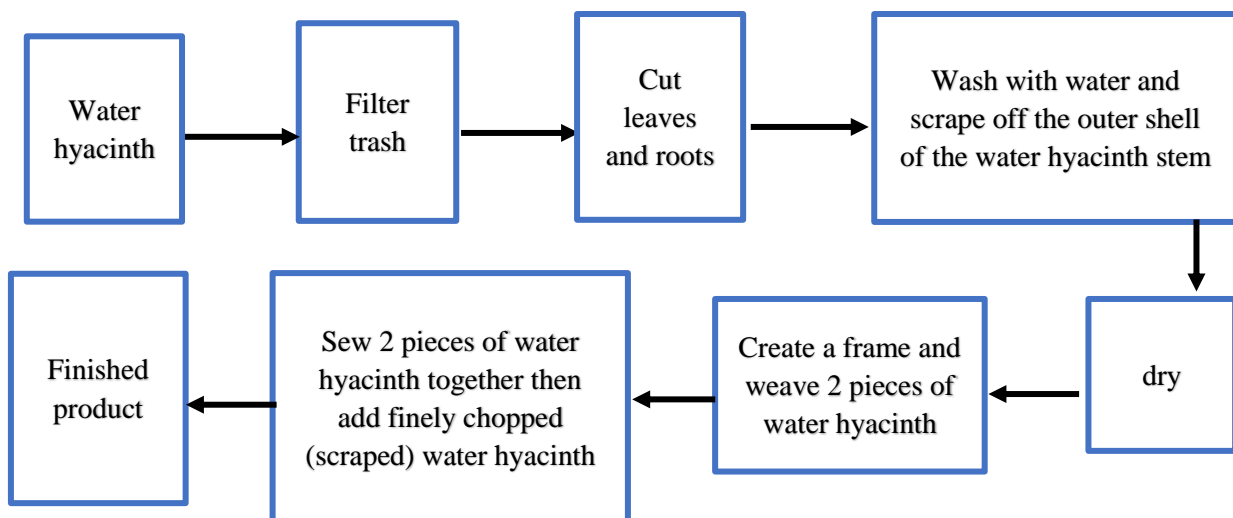


Diagram 1. Process of making water hyacinth carpet

Process of making products from water hyacinth: 8 steps

Time to pick up water hyacinth: 1 day to pick up water hyacinth

Steps:

Step 1: Collect ingredients

Students collect water hyacinths from Bach Dang river in Thu Dau Mot city, Binh Duong province.

Step 2: Filter trash from water hyacinth

Filter out moss, mud and dirt on water hyacinth. It is necessary to be careful and meticulous about filtering trash like this, because if not filtered, it can damage the details in the process of making the finished product.

Step 3: Cut the leaves and roots of the water hyacinth plant

Tree trunks have the ability to absorb oil faster and higher, helping to absorb oil from wastewater and absorb all oil spills, so unnecessary parts such as leaves and roots are removed.

Step 4: Wash with water and scrape the outer bark of the water hyacinth stem

Rinse with water to remove the mud and dirt on the stem so that grease can easily stick to it, then scrape the outer layer of the water hyacinth stem to help increase the oil absorption process more effectively.

Step 5: Dry the water hyacinth stem

Then, dry the water hyacinth in the shade, drying the water hyacinth for 5 sunny days.

Note:

- The average drying temperature for water hyacinth is from 25°C to 35°C, but the most optimal temperature is from 30°C to 32°C
- Water hyacinths should be dried in a cool, shaded place
- Avoid exposing water hyacinth to direct sunlight for long periods of time. Because water hyacinth fibers are brittle and break easily; The color of the water hyacinth fades
- Drying time for water hyacinth depends on weather conditions, but is usually 5 days
- When dried, water hyacinth will absorb moisture, so after drying, place the water hyacinth in a bag with a few desiccant bags and keep it in a dry place to avoid moisture and mold.

Step 6: Create a frame and weave 2 pieces of water hyacinth

Select zinc-aluminum bars with dimensions equal to the previously measured manhole: length (15cm), and minimum width (15cm). Then bond the aluminum zinc bars together with zinc.

Mark the distance to balance the piece so it fits evenly. Fix the water hyacinth thread at the marked place, then weave alternately until the frame is finished.

Describe the process of weaving water hyacinth pieces

Fix one end of the water hyacinth stem to the outer edge of the mold by threading the thread through the gap between the other two threads and tying a knot.

Continue knitting in the basic herringbone stitch: thread the yarn through the previous 2 strands, cross the yarn down, then thread the yarn through the next 2 strands and cross it up. Repeat this until one round is completed.

Note:

At the end of the first row, pull the water hyacinth stem back to tighten the stitches.

If you knit all the stems of the water hyacinth plant, add 2 new stems and attach them to the 2 old stems that were there before, then you can fix it with a stapler and continue knitting in a herringbone shape.

Continue knitting according to the instructions above until the previously measured size is achieved. In the final step, cut off the excess body, then you can use a stapler to fix it or thread it onto previously knitted threads.

Step 7: Fix the 2 pieces of water hyacinth together then put the finely cut water hyacinth in the middle
Fold the two previously knitted pieces together in opposite directions, one piece vertically, one piece horizontally. Then, fix the 2 pieces with thread

After sewing all 3 edges of the water hyacinth piece, leave 1 edge to add finely cut water hyacinth in the middle. This step helps the water hyacinth piece increase its ability to absorb cooking oil

Step 8: Products

The finished piece of woven water hyacinth can absorb cooking oils discharged down the drain from boarding houses, households and restaurants.

In short: Scrape the outer bark off the water hyacinth stem, weave it into pieces and then fold the two pieces together, then put the finely cut water hyacinth in the middle to increase the absorbency of cooking oil.

2.3 Method of sampling water contaminated with used cooking oil before and after treatment

2.3.1. Method of water sampling before treatment with water hyacinth pieces

Prepare a bowl, containing 900ml of tap water, then pour into the bowl, 100ml of used and discarded cooking oil, add and mix well. Then use a little water to rinse the PE bottle evenly and throw it away. Pour the rest into a 1liter PE bottle through a funnel to analyze the water sample before treating it with a water hyacinth piece. Analytical parameters will be animal and vegetable oils and fats.

2.3.2. Method for sampling water after treatment with water hyacinth pieces

Prepare a bowl, pour 900ml of water into the bowl, 100ml of used and discarded cooking oil, add them together and mix well. Then let this amount of water flow through an oil-absorbing water hyacinth pad underneath with an empty bucket placed to catch the water after passing through the water hyacinth pad. Take the amount of water absorbed by the water hyacinth and pour it into the funnel through a 1liter PE plastic bottle to analyze the treated water sample. Analytical parameters will be animal and vegetable oils and fats.

3. Results and discussion

3.1. The finished product is an oil absorbent pad made of water hyacinth

The 2-layer water hyacinth absorbent pad is sewn in place, has a large area that can absorb surfaces and absorb all types of oil residue remaining on the water. Inside the absorbent pad, finely cut water hyacinth is placed inside to increase the absorbency of cooking oil. When conducting the experiment, the cooking oil was significantly filtered (using visual and sensory methods, the research team found that when used cooking oil flows through the absorbent pad, the water will be clearer and less oily than before. The water hyacinth's head and water hyacinth pieces are smeared due to oil scum clinging to them). Thus, with this method, the oil absorbent pad has a higher absorbency than previous methods. The product size is 15cm × 15cm. The product weight is 250 grams.



Figure 1. Water hyacinth is finely chopped



Figure 2. Water hyacinth pad product absorbs cooking oil scum completely



Figure 3. The water has cooking oil residue that has not been treated by the water hyacinth piece



Figure 4. The water hyacinth pad absorbs oil residue and is tested for its ability to absorb oil

Comment:

When using water hyacinth pads to absorb oil scum, it brings high results in absorbing oil scum and removing oil residue from drains and dishwashing drains of households. Oil scum absorbent water hyacinth pads can be used to filter cooking oil in wastewater pipes of restaurants and eateries because oil scum absorbent pads are highly effective and easy to apply. The product has the ability to absorb animal and vegetable oils and fats after frying and cooking. Excess grease in the pan can be wiped off with a paper towel, then rinsed with water and poured into the water hyacinth. The water hyacinth will hold the remaining grease to limit grease from draining down the drain.



Figure 5. Water has cooking oil residue after being treated with water hyacinth pieces



Figure 6. Products and results

3.2. Take samples of oil-contaminated water before treatment and after treatment using a water hyacinth piece

Take water samples before treating oil-contaminated water

Prepare a bowl, pour 900ml of tap water into the bowl, 100ml of used and discarded cooking oil, mix well. Then use a little water to rinse the PE bottle and throw it away, then pour the rest into a 1liter PE bottle through a funnel to analyze the water sample before treatment.

Take water samples after treating oil-contaminated water

Prepare a bowl, pour 900ml of water into the bowl, 100ml of used cooking oil and mix well. Then let this amount of water flow through the water hyacinth oil absorbent pad, underneath there is an empty bucket to catch the water after passing through the water hyacinth pad. Take the amount of water that has been absorbed by pouring water into the funnel through a 1liter PE plastic bottle and analyze the treated water sample.



Figure 7. Two bottles containing the results were analyzed

The bottle on the left is water contaminated with untreated discarded cooking oil; The bottle on the right is after treatment with water hyacinth pieces.

3.3 Results of water sample analysis before and after treatment with water hyacinth pieces



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Số: 00123/2024/KQTN/01 **PHIẾU KẾT QUẢ THỬ NGHIỆM** 07/03/2024

1 Địa điểm lấy mẫu : HỘ GIA ĐÌNH
 2 Địa chỉ : HỘ GIA ĐÌNH
 3 Ngày nhận mẫu : 29/02/2024
 4 Loại mẫu : Nước thải
 5 Ký hiệu và mô tả mẫu : 240229.01NT1: Nước vẩn dầu trước xử lý
 240229.01NT2: Nước vẩn dầu sau xử lý bằng lục bình
 6 Phương pháp lấy mẫu và bảo quản mẫu : Khách hàng gửi mẫu
 7 Kết quả đo đạc, phân tích:

Stt	Thông số	Đơn vị	Kết quả		QCVN 14:2008/ BTNMT Cột B	Phương pháp đo đạc, phân tích
			240229.01NT1	240229.01NT2		
1.	Dầu mỡ động thực vật ⁽¹⁾	mg/L	840	18,6	20	SMEWW 5520B&F:2023

Ghi chú: Kết quả đo đạc và phân tích có giá trị trên mẫu thử và tại thời điểm đo:
 - ⁽¹⁾ Thông số được Bộ Tài nguyên và môi trường công nhận;
 - KPH: Không phát hiện MDL: Ngưỡng phát hiện

PHÒNG THỬ NGHIỆM



HOÀNG ANH TRÚC ĐOÀN



GIÁM ĐỐC
TRẦN NGUYỄN THỊ HUỖN

Figure 8. Water analysis results sheet before treatment and after treatment performed by the Environmental Technology and Occupational Safety and Health Consulting Center.

Water analysis results:

According to the analysis results of water containing cooking oil scum, before treatment, the concentration of total animal and vegetable oil and grease in the water was still quite high (240229.01NT1. Before treatment, it was 840 mg/l), when filtered, Passed by absorbent pads made from cooking oil scum made from water hyacinth (240229.01NT2. After treatment, it is 18.6 mg/l). According to the regulations of QCVN 14:2008/ BTNMT (Column B) 20 mg/l or less, the result of water contaminated with cooking oil after treatment with an absorbent pad made of cooking oil scum using materials from water hyacinth achieves QCVN 14:2008. /BTNMT (Column B).

Comment: With the above water sample analysis results, the research team's cooking oil absorbent pads are basically effective in treating oil-contaminated wastewater.

4. Conclusions and recommendations

4.1. Conclusions

Research on the oil absorbent pad product made from water hyacinth material has been successfully carried out according to the research objectives set out. The goal is to use water hyacinth to make an environmentally friendly oil absorbent pad from rarely used materials. While reducing the amount of daily waste and protecting national resources, on the other hand, the cost of producing oil absorbent pads from water hyacinth is quite low. After 4 methods, we have found a way to create an oil-absorbent pad that has the ability to absorb oil quite well, meeting the requirements of the test. In addition, the research team also practiced mixing and sampling water before and after treatment with an oil-absorbent pad for analysis. The results of analyzing the water containing oil scum, before treatment, the concentration of total cooking oil in the water was still quite high (240229.01NT1. Before treatment, it was 840 mg/l), when the water hyacinth piece absorbed the oil scum. (240229.01NT2. After treatment, it is 18.6 mg/l). According to QCVN 14:2008/BTNMT (Column B) 20 mg/l or less, the result of oil-contaminated water after treatment with oil-absorbent hairpieces meets QCVN 14:2008/BTNMT (Column B).

This is the result that shows us that using water hyacinth pads to absorb oil residue can achieve high efficiency in treating oil-contaminated water. This oil absorbent pad can be widely used in snack shops, housing areas, schools, supermarkets, restaurants, etc. And can be used to absorb oil spills on rivers and at sea.

4.2. Recommendations

Products from the research can be used for useful development applications outside the market, such as absorbent water hyacinth mats for sewer pipes in dining areas, dishwashing areas and sewer systems... with high applicability in life. Living. Small businesses can apply this method to remove all cooking oil left behind. Not only does it reduce costs because it is made from discarded materials, it also reduces the amount of waste significantly. In addition, it also protects increasingly depleted forest resources and reduces the greenhouse effect.

References

- Vũ Thị Hải Ninh., Trần Thị Mừng (2021). How laundry detergent is made from used vegetable oil at some households in Son La. Tay Bac [Chế tạo nước giặt từ dầu thực vật đã qua sử dụng tại một số hộ gia đình ở Sơn La]. *University Journal of Science*, 24, 104-108. <https://sj.utb.edu.vn/tckh/article/view/311/315>.
- Ngô Thị Ngọc Hân., Bùi Thị Bửu Huệ (2022). Synthesis of biological lubricants from catfish fat, basa fish fat and used vegetable oil [Tổng hợp mỡ bôi trơn sinh học từ mỡ cá tra, cá basa và dầu thực vật đã qua sử dụng]. *Can Tho University Journal of Science*, 13, 50-58. <https://ctujsvn.ctu.edu.vn/index.php/ctujsvn/article/view/734>
- Linh Lan Hoàng (2014). Research on converting waste cooking oil into liquid fuel using catalytic cracking method [Nghiên cứu chuyển hóa dầu ăn thải thành nhiên liệu lỏng bằng phương pháp cracking xúc tác] (*Thesis*). Hanoi University of Science and Technology.
- Nguyễn Quang Lộc, Lê Văn Thạch & Nguyễn Nam Vinh (1997). Oil pressing and grease processing techniques, food Kỹ thuật ép dầu và chế biến dầu mỡ, thực phẩm]. Publishing scientific and technical
- Phạm Quốc Nguyên, Đoàn Chí Linh, Trương Quốc Phú, Nguyễn Văn Công (2015). Evaluating the ability to remove pollutants from pangasius (*Pangasianodon hypophthalmus*) ponds using water hyacinth (*Eichhornia crassipes*) on a runoff wetland model [Đánh giá khả năng loại bỏ chất ô nhiễm ao nuôi cá tra (*Pangasianodon hypophthalmus*) bằng lục bình (*Eichhornia crassipes*) trên mô hình đất ngập nước dòng chảy mặt]. *Can Tho University Journal of Science*, 58-70. <https://ctujsvn.ctu.edu.vn/index.php/ctujsvn/article/view/2362>.
- Nguyễn Trung Sơn, Đỗ Thị Diễm Thuý & Đinh Thị Ngọc (2012). Research on biodiesel synthesis from waste cooking oil using MgSiO₃ heterogeneous catalyst [Nghiên cứu tổng hợp biodiesel từ dầu ăn phế thải trên xúc tác dị thể MgSiO₃]. *Vietnam journal of chemistry*, 48(6)- 780-785 <https://doi.org/10.15625/2249>.
- Lê Hoàng Việt, Nguyễn Xuân Hoàng (2004). Wastewater treatment with water hyacinth [Xử lý nước thải bằng lục bình]. *Can Tho University Journal of Science*, 2, p.91-95.
- Taylor K.G, Bates R.P & Robbins R.C. (1971). Extraction of protein from water hyacinth. *Hyacinth control J*, 9, 20-22.