Synthesis of Detergent from Rice Husk

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Abstract: The project's primary goal is to create a detergent powder from paddy husk ash. mesoporous silica is used as a raw material in a variety of applications, including detergents and soaps, as well as a refractory component. Sodium silicate is formed by reacting rice husk ash (RHA) with aqueous NaOH, and silica is precipitated from the sodium silicate via acidification. In these experiments, approximately 90% of the silica contained in RHA was converted into sodium silicate in an open system at temperatures around 100°C. The results showed that silica derived from RHA is mesoporous, with a large surface area and a small particle size. Rice husk is typically mixed with coal and used to fire boilers. As a result, carbon particles are frequently found in RHA. The carbon already present in RHA was used to create activated carbon embedded on silica. This carbon has a high adsorption capacity. The filtrate is made up of sodium phosphate. Therefore, the use of high concentration of Sodium and completely ashed rice rusk will result in a better Sodium silicate quality for detergent production.

Key Words: Rice husk, Detergent, refractory component, Production

1. Introduction

Rice Scenario

Rice is one of the main cereal crops, as well as staple food for most of the world's population, especially Asian countries [1]. Approximately 600 million tons are harvested worldwide annually [2]. Frequently, rice is eaten in cooked form by humans to obtain various nutrients, as well as to supplement their caloric intake [3]. The milling of paddy rice has nearly a 70% yield of rice (endosperm) as its major product, although there are some unconsumed portions of the rice produced, such as rice husk (20%), rice bran (8%) and rice germ (2%). Rice is one of the most important staple foods for nearly half of the population in the world [4]. The worldwide production area for rice is about 150 million hectares, while the annual production is about 590 million tones [5]. The Asian region produces approximately 90% of the total global rice output, to which Chinaand India contribute 28.7% and 19.5% shares of the total output, respectively.

Table 1. State wise rice production in India

State	Area (In million ha.)	Production (Mill Tons)	Productivity
Andhra Pradesh	4.39	14.24	3246
Chhattisgarh	3.73	4.39	1176
Karnataka	1.51	3.80	2511
Orissa	4.45	6.81	1529
Punjab	2.74	11.00	4022
Tamil Nadu	1.93	5.18	3389
Uttar Pradesh	6.03	13.10	2171
West Bengal	5.94	15.04	2533

Figure 1 Worldwide production area of rice

Rice husk is an agricultural waste material abundantly available in rice-producing countries. They are the natural sheaths that form on rice grains during their growth. Removed during the refining of rice, these husks have no commercial interest [6]. The annual world rice production amounts toapprox. 400 million metric tons of which more than 10% is husk [7]. A large quantity of husk, which is known to have a fibrous material with a high silica content, is available as waste from rice-milling industries. The major constituents of rice husk are cellulose, lignin and ash varying with the variety, climate and geographic location of growth. The white ash obtained from the combustion of this raw material at moderate temperature contains 87±97% silica in an amorphous form and some number of metallic impurities [8]. rice husks are an excellent source of high-gradeamorphous silica. This silica has been shown to be a good material for the synthesis of very pure silicon, silicon nitride, silicon carbide and magnesium silicide Utilization of rice husk as a resourceof silica is based on removal of impurities with low effort and the high specific surface. Also, disposal of rice husk is frequently a major challenge in rice-producing regions, and it is frequently addressed by indiscriminate dumping and pile burning, which contributes to global warming and health issues [9]. This highlights the importance of using rice husk (which is considered waste) toproduce sodium silicate. Currently, a lot of enterprises burn rice husk to produce energy as an alternative fuel, which is a good answer, but regretfully creates rice husk ash as a new waste (RHA). This combustion-derived ash comprises about 60% silica and a small number of metalliccontaminants [10]. There is another approach that is based on the reaction of silica with sodium

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hydroxide (NaOH) solution in an autoclave, despite the fact that the calcination process is typicallyemployed in the industry. Because it uses less energy temperature than the traditional calcination method, the latter procedure provides an advantage. As a result, the silica content of RHA will beused in this study by interacting with sodium hydroxide to create sodium silicate, which will thenbe used to make detergent [11].

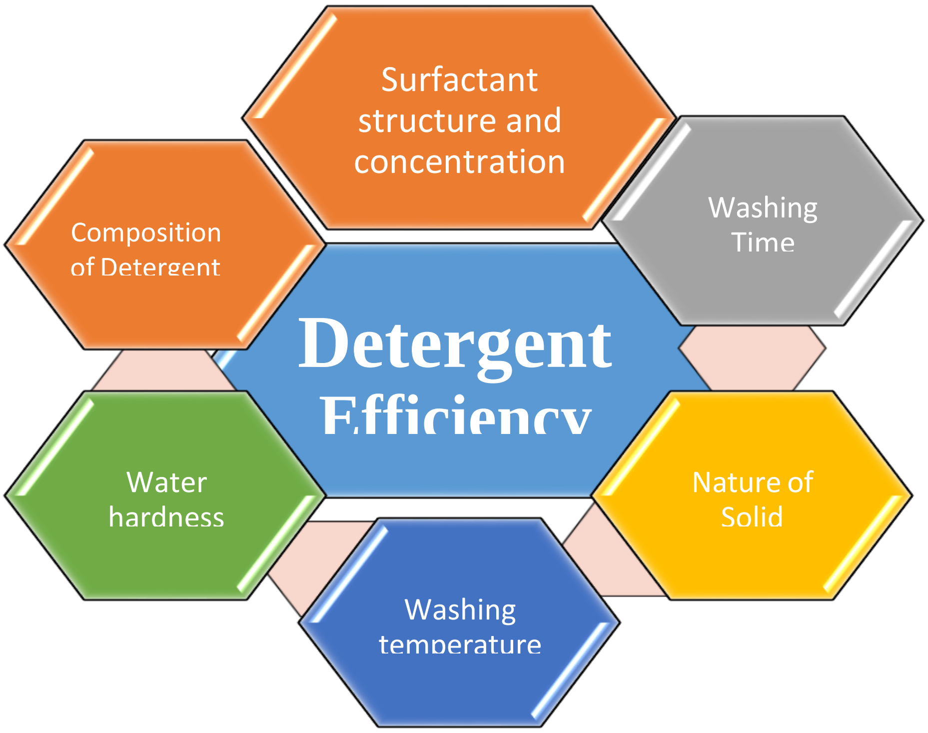
Countries	Rice crop	Predicted rice husk	Predicted rice straw	Energy potential
China	212.68	42.54	212.68	638.03
India	168.50	33.70	168.50	505.50
Indonesia	81.38	16.28	81.38	244.15
Bangladesh	48.98	9.80	48.98	146.94
Vietnam	42.76	8.55	42.76	128.29
Thailand	33.38	6.68	33.38	100.15
Myanmar	25.62	5.12	25.62	76.87
Philippines	19.28	3.86	19.28	57.83
Brazil	12.47	2.49	12.47	37.41
Pakistan	11.17	2.23	11.17	33.52
Cambodia	10.35	2.07	10.35	31.05
Nigeria	9.86	1.97	9.86	29.59
Japan	9.78	1.96	9.78	29.59

Table 2. Globally rice, husk straw and energy production

Detergents.

Detergent industry is a big market all over the world and has a strong influence on people's daily lives. The word detergent, as an agent for wiping things, was used in 1676 for the first time and the year 2016 was the 100 years from the date of synthetic one’s commencement. In fact, each material with the ability to act as a cleaning compound, instead of soap, could be considered as a detergent to remove dirt from a surface [12]. On the other hand, detergency is referred to a liquidcapability to eliminate every undesirable matter as soils from a solid surface. The efficiency of thisprocess is dependent on several factors such as the nature of the solid surface, washing time and temperature, composition of detergents, etc.

Figure 2 Detergent Efficiency of different parameters.



It should be considered that the reduction in phosphate extent or its complete removal from detergent formulation without any desirable replacement would cause some disadvantages. It candisturb the primary and secondary washing performances which leads to hygiene and cleanliness concerns. Additionally, the features of laundered clothes and their persistence are affected by moreincrustation and reduction in lifespan of washing machines as a result of lime precipitation. Hence,efficient and environmentally friendly detergents must be considered in order to reduce environmental impacts [13].

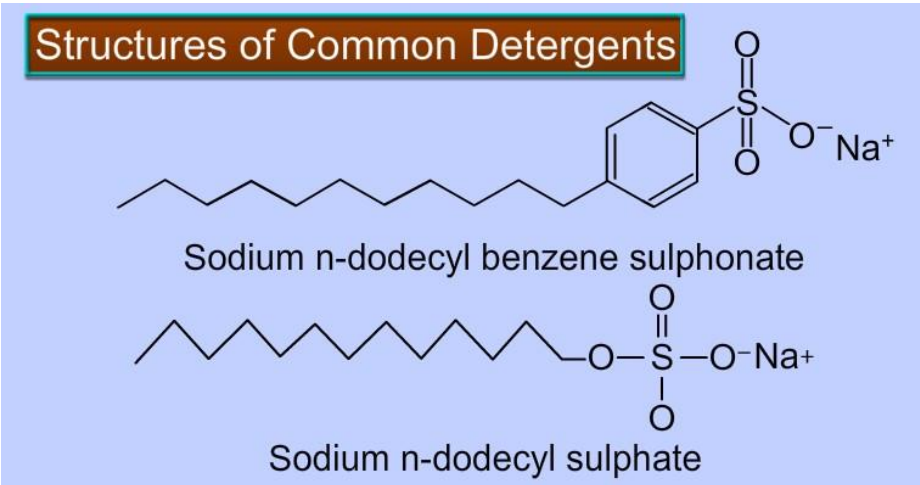


Figure 3 Structures of Common Detergent

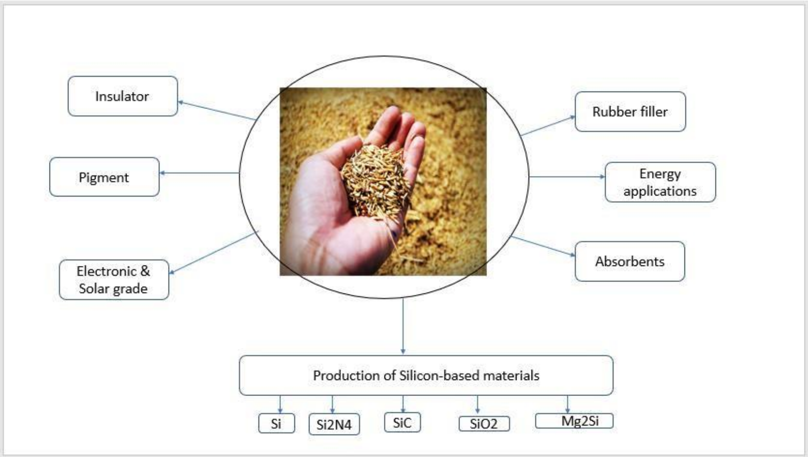
Figure 3. represents a schematic of conventional detergent components which usually contains two main parts as hydrophobic chain and hydrophilic group. Amphipathic compounds with hydrophobic and polar groups form detergents. The polar group is located at the end of the hydrophobic carbon chain in these compounds. In contrast to completely polar or non-polar molecules, amphipathic molecules exhibit special chemical characteristics in

water. The polar group in detergent forms hydrogen bonds with water molecules in water, while hydrophobic reactions aggregate the hydrocarbon chains [14]. These properties enable detergents to be water-soluble. Furthermore, when detergent or soap dissolves in water, their molecules form micelles. The molecules' polar ends are then on the outside of the cluster, while their non-polar ends are in the center. They form spherical structures known as micelles in aqueous solutions, each of which contains numerous detergent molecules. Again, detergent is also known as a surfactant because it lowers the surface tension of water. Most of the time, the substances are alkylbenzene sulfonates, a class of compounds similar to soap but soluble in hard water. In these compounds, the detergent's polar sulfonate is less likely to bind with calcium and other ions in hard water than the soap's polar carboxyl [15].

Figure 4 Different products of rice husk

2. Literature Survey

(Johan et.al, 2016) It is known that the white ash was mostly amorphous, and the mineral commonly found when



heating rice husk was not found. Even after the RH was burned at 1000 degrees, the amorphous part was still fashioned. This demonstrated that the acid dissolved a portion of the carbon compounds in the rice husk, followed by cathartic of metal and different alkali cations, and thus amorphous high oxide ash was formed without the incorporation of crystal phases such as minerals. The polished RHA was reborn successfully as ZSM5, a water softener that is widely used as a catalyst in the rock oil industries.

(Hossain sk et.al, 2018) Waste or byproducts from various enterprises, particularly farming, have recently received increased attention in the logical, innovative, natural, monetary, and social circles. RH may be caused by the rice processing, and RH fiery remains. RHA is created by burning in a completely different evaporator. In rice-producing countries such as China, the United States, India, Brazil, and Southeast Asia, rice husk and rice husk ash are widely available. Rice husk has thus been reused through intense energy generation. This results in RHA with a high concentration (85-95%) of nebulous silicon oxide. RHA has been used in various fields for the collection of various silicates, zeolites, impetuses, nanocomposite, bond, light-weight development materials, encasings, and adsorbents in recent decades.

(Sekifuji R et.al, 2019) In his research, he discovered that RH are assets that should be reused economically, resulting in a successful win-win relationship between partners, customers, and society. Silica is a vital material that is used for a variety of modern applications. A RH contains silica at a concentration of 20% by weight and can thus be considered a natural silica mineral. The fiery remains delivered from consuming rice husks should also be used as an asset to reuse RH in a sustainable manner. In this study, we considered the financial feasibility of two reusing frameworks: heat recuperation from high temperature water and age of power from boiling water, based on the idea that RH fiery remains should be reused as silica compost.

(Korotkova TG et.al, 2016) RH and the artificial creation of RH and residue are a misuse of the Regulus crude rice developing in the Krasnodar Region of the Russian Federation. Rice residue is formed as a result of the discharge of crude rice from vehicles, the evacuation of polluting influences, and the composition by size, as an example, throughout the division of films, pounding, granulating, cleaning, moving grain on lifts and transports, and each innovative activity in the creation of rice groats. As a result, on evacuated dirt, the gathering violent wind and also the sack channel hurricane are introduced within "Southern Rice Company," LLC's gas passing on frameworks and suction plants. The paper shows the artificial creation of husk tests, dirt control by the gathering hurricane, and residual control.

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(Jongpradist et.al, 2018) The potential and productivity of using rice husk remains (RHA) to include or partially replace Portland concrete in the deep bond blending method are investigated. The RHA impact on the blend properties is investigated through a series of unconfined pressure tests on concrete RHA-balanced out mud. Its effectiveness in increasing quality by incomplete bond substitution to obtain high-quality soil concrete is given uncommon consideration, and it is contrasted with fiery remains. If the concrete substance in the blend is greater than 10%, test results show that up to 35% RHA could be beneficially used to improve the quality. At 28 days, the RHA improves the standard admixed dirt in the concrete by more than 100%.

(Abiodun Y et.al, 2018) Recycling of agricultural wastes such as RHA and pozzolan was discovered to be increasingly encouraged, particularly in developing countries. A preliminary investigation into the chemical and physical constituents of RHA victimisation was conducted in this paper using completely different techniques. SEM images of the RHA revealed residual pores distributed throughout the ash sample, implying that the silicon dioxide could be an extremely porous material with an oversized internal expanse. In comparison to "Faro 58," samples burned at 4000C for 6 hours and 6000C for 4 hours for "Bukus" and "Soro/Olomo nla" show aggregates with clearly outlined layers of loose flakes. The energy-dispersive X-ray spectrometry (EDX) analysis was carried out to see if there were any percentages of oxide gift within the samples.

(Ziegler D et.al, 2016) 154 looked into the potential of two mechanical wastes, fly fiery scrap (FA) and RHA, as raw materials for the production of geopolymer glue. Three types of tests were delivered: (I) halloysite motivated with potash and nano-silica, used as the reference test (HL-S); (ii) halloysite acted with RH fiery scrap stony-broken up into KOH arrangement (HL-R); (iii) solfa syllable initiated with the antacid arrangement acknowledged with the RH powder (HL-R); (iv) solfa syllable initiated with the antacid arrangement acknowledged with (FA-R). Thick and permeable examples were created to represent mechanical characteristics as well as ecological impact. The flexural and compressive strengths of HL-R were approximately nine and forty-three MPa, respectively. Contrary to popular belief, FA-R has a significantly lower compressive quality than HL-R, despite having an equivalent flexural quality.

(Gupta P et.al, 2019) investigated that vast soil covers a mere fraction of an Asian country's total area, particularly in the states of Gujarat, the geographical region, Madhya Pradesh, Karnataka, Rajasthan, and Andhra Pradesh Metamorphic rock, basalt, basic volcanic ash, calcarious metallic elements, and matter rocks containing calcarious shales, limestones, slates, and sandstones are all residually derived from expansive soils. To a large extent, the underlying bedrock of black cotton soil is volcanic rock or traps. Black cotton soil forms as a result of subaerial weathering of unmoved basalts and future admixture of worn merchandise with iron and organic matter. Expansive cohesive soils are associated with a variety of issues such as volume shrinkage, coefficient of expansion, low cosmic background radiation value, Swelling Index, and so on.

(Atamanov et.al ,2018) The experimental results for the thermal detoriation of hydroxylammonium nitrate (HAN) in the presence of activated carbon with a high specific floor (up to 3000 m2/g) obtained by activating RH with

potassium hydroxide at 700 °C in a rotating spherical furnace. The expansion of initiated carbon reduces the temperature of the start of HAN deterioration from 185 to 86 0.5 °C. At a pressure of 6 MPa, the consuming expense of HAN doped with initiated carbon increases to 400 mm/s. It has been demonstrated that the expansion of initiated carbon reduces the amount of NOx gases delivered by decay by up to 30%.
(Zhang Y et.al, 2014) RH, an agricultural byproduct, is converted into copper sorption from aqueous solution. Chemical modifications such as treating RH with H3PO4 increased RH's sorption capability for Cu (II). This study investigated the sorption properties of Cu (II) and tested the most satisfying approaches to sorption situations. The basic compositions of local RH and H3PO4-treated RH were determined using (XRF) analysis. The morphological and structural properties of H3PO4-treated RH were evaluated using SEM. The adsorbent's surface functional businesses (i.e., carbonyl, hydroxyl, and carboxyl) were tested using FTIR (toes-IR) and contributed to Cu (II) adsorption.

(Hossain SK et.al, 2018) In recent years, there has been a growing interest in the clinical, generational, ecological, monetary, and social spheres in the use of waste or by using merchandise from unique industries and the agricultural sector. RH is a byproduct of rice processing. RH fiery debris (RHA) is produced by a different kettle burning method. Rice-growing countries such as India, China, Brazil, Southeast Asia, and the United States have an abundance of RH and RHA. As a result, RH has been recycled by burning it for energy production. This results in RHA, which contains a massive amount of undefined silica (85-95%). In recent decades, RHA has been widely used in a variety of fields for the fabrication of various silicates, zeolites, impetuses, nanocomposites, bonds, light-weight development materials, and so on.
(Joshghani A et.al, 2018) The effect of sugarcane-bagasse ash (SCBA) and RHA as cement substitute substances on the mechanical and durability properties of mortars was investigated on this basis. RHA and SCBA, depending on the weight of cementitious materials, change Portland cement at an average price of 10-30% and 10-25%, respectively. In addition, ternary combinations have been organised by combining both components. Replacement dosages were chosen primarily based on previous research studies that forged the mortar. In addition, a manipulated aggregate containing the most effective cement was transformed into a preparation to demonstrate the efficacy of substitute materials. Compressive power tests were carried out to evaluate the mechanical performance of the specimens.
(Sensale R et.al, 2015) optimised a residual RHA for use as a mineral additive in high-performance concrete The research focuses on the effect of various cement substitute probabilities via residual RHA on the durability and mechanical properties of high-overall performance concrete components. At 28 days, the compressive strength development to 1- 12 months is considered along with splitting tensile, modulus of rupture, and elasticity modulus. The test also looks at alkali-silica response. The study used four residual RHA replacement degrees (5%, 10%, 15%, and 20%) via volume and four watercementitious materials ratios. The properties of concrete RHA were also compared to those of Portland concrete cement without rice husk ash.

3. Method and materials

3.1 Rice Husk Acquisition and Sample Preparation

The rice husk used in this study was obtained from Navya Agri allied (amazon). This material was sundried for two (2) days to reduce any moisture content. Thereafter, it was sieved to remove the rice grains content in the husk to ensure that the burning of the rice husk will not be hindered by them. Then, 50g of the rice husk was put in a crucible and placed in the electric furnace (Figure4) at a set temperature of 650ºC. After attaining the temperature of 650ºC, it was allowed to stay in the furnace for 3 hours. Afterwards, two (2) Sodium hydroxide (NaOH) solutions were prepared with 4g pellets to 200mL of deionized water. The solutions were allowed to ferment for 48 hours to ensure complete dissolution and mixing of the NaOH pellets.

3.2 Production of Sodium Silicate:

To produce the Sodium silicate from the rice husk ash (RHA) after pre-treatment process, five (5) grams of RHA were reacted one mole (1M) of Sodium hydroxide (NaOH) solution in the beaker. These solution were stirred thoroughly with a glass rod to ensure miscibility. They were thereafterplaced in the hot air oven at a temperature of 100oC for an hour. After this, the beaker and its content were removed from the oven and pour on filter papers. The residues on the filter papers were dried at a temperature of 60oC in the oven for about 30 minutes. The viscous residues (products) on the filter papers are the Sodium silicates (Na2SiO3) obtained from 1M NaOH from the process.

3.3Production of Detergent

The basic components used in the production of the detergent are presented in Table 1. fifty (50) millitres (mL) of the fermented Sodium hydroxide (NaOH) solution was poured into a 1000mL beaker. Then, 10mL of the Sodium silicate (Na2SiO3) from 1M NaOH (Sample A) and 100mL of the palm kernel oil were added into the beaker and stirred continuously. Also, 50g of soda ash and10g of the Sodium Tripolyphosphate (STPP) were added to the solution in the beaker while stirring was going on. Thereafter, Ammonia in proper mixing as a drying agent and Hydrogen peroxide were added to the solution and the stirring speed was increased to enhance the detergent process formation. Figure 5 a and b shows some of the detergent production stages. As the detergent formation process was on-going, 20mL of apple fragrance and 50g of the colour granules were added to the detergent. The formed detergent was left for 24 hours to dry out and then a sieve wasused to reduce the detergent particle size to powdery form. Afterwards, the properties, namely, foaming stability, stain removal ability, alkalinity value, and moisture of the produced detergents were determined.

Figure 6 Final slurry of product

4. Result and Discussion

The rice husk ash (RHA), when it burned in an electric furnace for 3 hours and 6 hours, respectively, whereas 4 reveals the RHA's weight at each time interval, which was determined at a temperature of 700oC. reports, there was a reduction in the RHA weight with passing time. Naturally, this was anticipated as it shows that the component, namely that the rice husk's carbon content was turning to ash and reducing the weight of the rice straw. Silicate (SiO2) is the ingredient that makes up the majority of RHA. Resulting fromtheir chemical interaction Sodium silicate is produced as a result of the reaction between sodium hydroxide (NaOH) and silicate (SiO2) (Na2SiO3) together with water (H2O). Displays how much sodium silicate was produced at Various temperatures and NaOH mole concentrations. It has been shown that the sodium silicate volume as the temperature rises, (Na2SiO3) shows a decrease. Due to the difference in RHA Sodium Silicates (Na_2SiO_3), Samples A and B (Na_2SiO_3 for 1M NaOH) Industrial Sodium Silicate (Na_2SiO_3) was not considerable, and samples A and B (Na_2SiO_3 from 2M NaOH) and utilized to produce the detergent in accordance with the general process order listed below.

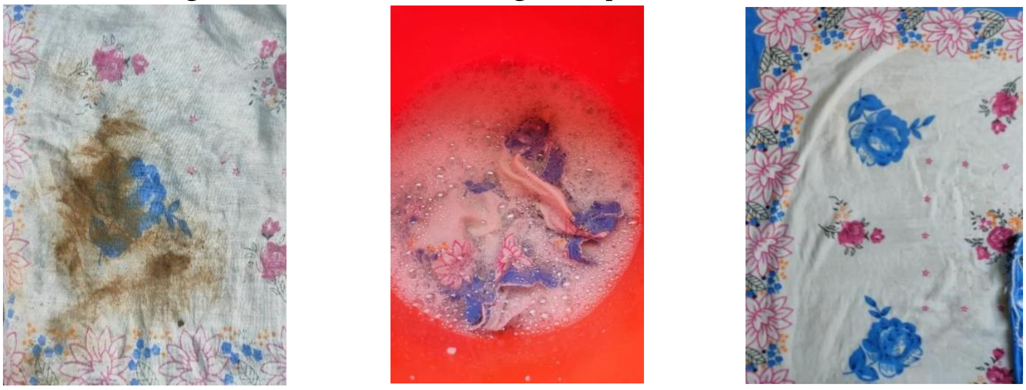

Figure 7 Final Product (Detergent)

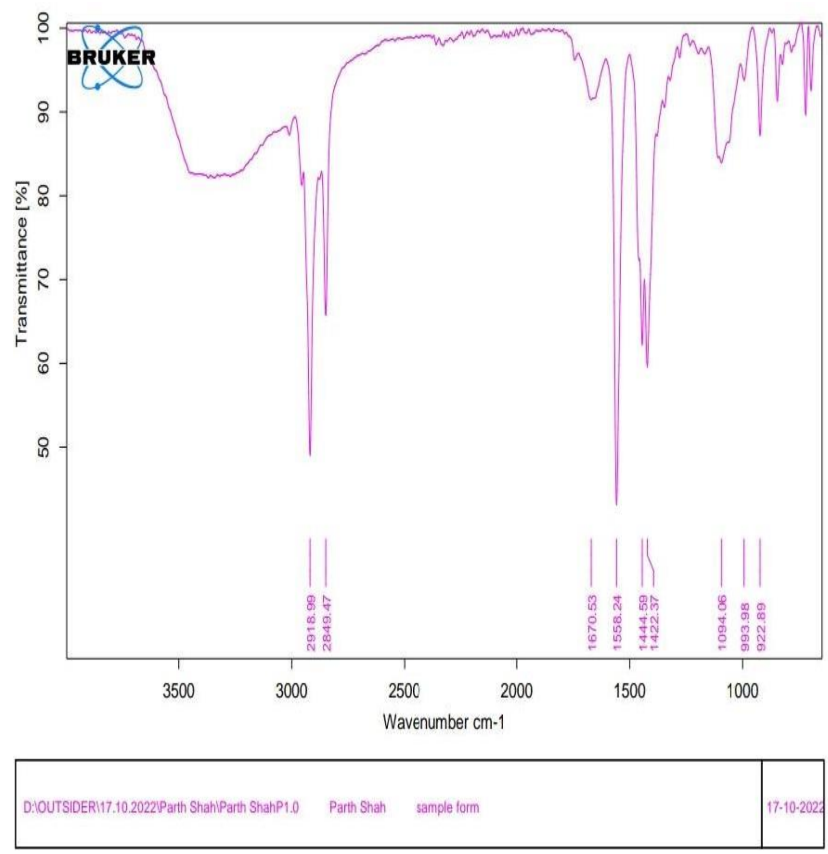

Figure 8 Ft-IR Of Product (detergent)

5. Conclusion

Silicate in the manufacture of detergent Findings is drawn the following conclusions may be drawnfrom this study on the use of RHA Sodium.

i) The RHA Sodium Silicate (Na2SiO3) has a pH value that is comparable to industrial SodiumSilicate and is only miscible in both water and 95%w/w alcohol (Na2SiO3).

ii) They both mix in organic oil to form an emulsion, and the RHA sodium silicate was somewhatmore viscous than the commercially sodium silicate.

iii) The foam durability, free alkali, pH level, and other features of the detergent made from RHASodium Silicate were comparable to those of detergent made from standard Sodium Silicate.

It is advised that additional research examine a successful method for pre-treating the RHA toreduce other substances that might act as contaminants in the synthesis of sodium silicate.

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