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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
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ВЕСТНИК
НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

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NAS RK is pleased to announce that Bulletin of NAS RK scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of Bulletin of NAS RK in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential multidiscipline content to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабаршысы» ғылыми журна-лының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабаршысының Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді мультидисциплинарлы контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Вестник НАН РК» был принят для индексирования в Emerging Sources CitationIndex, обновленной версии Web of Science. Содержание в этом индек-сировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Вестника НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному мультидисциплинарному контенту для нашего сообщества.

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COMPARATIVE ANALYSIS OF BIOFUELS WITH A FEEDSTOCK FUEL COMPLEX.

Abstract: Biofuels are viewed as a possible fuel of the future. Concerning energy for cars there is intense "competition" stemming from electricity and rising in popularity due to modern research is also hydrogen. In general, biofuels are nowadays strongly supported in the European Union as well as in the United States of America and many other regions of the world.

Active management in the oil and gas industry needs to take in account knowledge not only about fossil fuels but also various types of alternative fuels like biofuels. This thesis goal is to analyze the economics of producing Bio-Crude oil from a plant called Jatrophae curcadis, (or also known as "purging nut"). It is nowadays growing around subtropical regions of the North American continent, especially in Mexico, and southern Asia, and with lower yield can grow even in arid wastelands of Central Asia (in arid Mali it is grown to hold wildlife from plants). It is the very undemanding plant so the biofuel produced from it can be very cheap compared to other biofuels.

The oil produced from this plant is not being traded on commodities markets yet but is viewed as biofuel of the future as currently sold soybean oil and palm oil are according to my analysis more expensive in many areas of the world. Production of the plant seeds (nuts) when pressed leads to bio-crude oil which can be processed to biocrude.

Economic analysis showed that given irrigation and good genetic selection of the plants to give higher production of seeds (price of the kg would be determining factor), the biocrude produced from the seeds has the potential to successfully compete with alternative fuels made from soybean or palm oils.

Key words: diesel, gas, management, economic analysis, jatrophae curcadis, bio-crude, oil.

Introduction. Leaves, which show anti leukemic activity, contain alpha-amyrin, beta-sitosterol, stigmasterol, and campesterol, 7-keto-beta-sitosterol, stigmast-5-ene-3-beta, 7-alpha-diol, and stigmast-5-ene-3beta, 7 beta-diol (Duke, 2000)

The poisoning is an irritant, with acute abdominal pain and nausea about 1/2 hour following ingestion. Diarrhea and nausea continue but are not usually serious. Depression and collapse may occur, especially in children. Two seeds are strong purgative. Four to five seeds are said to have caused death, but the roasted seed is said to be nearly innocuous. Bark, fruit, leaf, root, and wood are all reported to contain HCN (Hydrogen Cyanide) (Watt and Breyer-Brandwijk, 1962). Seeds contain the dangerous toxalbumin curcin, rendering them potentially fatally toxic.

The "crude oil" pumped out of the ground is a black liquid called petroleum. This liquid contains aliphatic hydrocarbons, or hydrocarbons. The carbon atoms link together in chains of different lengths. Hydrocarbon molecules of different lengths have different properties and behaviors.

For example, methane, a gaseous molecule, is a chain with just one carbon atom in it (CH_4) and is the lightest chain. Methane is a gas so light that it floats like helium. As the chains get longer, they get heavier. The first four chains -- CH_4 (methane), C_2H_6 (ethane), C_3H_8 (propane) and C_4H_{10} (butane) -- are all gases, and they boil at -161, -88, -46 and -1 degrees F, respectively (-107, -67, -43 and -18 degrees C). The chains up through $C_{18}H_{32}$ or so are all liquids at room temperature, and the chains above C_{19} are all solids at room temperature (HowStuffWorks.com, 2009).

The petroleum refining industry converts crude oil into more than 2500 refined products, including liquefied petroleum gas, gasoline, kerosene, aviation fuel, diesel fuel, fuel oils, lubricating oils, and raw material for the petrochemical industry. Petroleum refinery activities start with receipt of crude for storage at the refinery, include all petroleum handling and refining operations, and they terminate with storage preparatory to shipping the refined products from the refinery. The petroleum refining industry employs a wide variety of processes. A refinery's processing flow is largely determined by the composition of the crude oil raw material and the chosen slate of petroleum products. The example refinery flow scheme presented in Figure 4 shows the general processing arintervalment used by refineries in the United States for major refinery processes. The arintervalment of these processes will vary among refineries, and few, if any, employ all of these processes (EPA,1995).

Listed below are five categories of general refinery processes and associated operations (in reference to Figure 4):

1. Separation processes: involves atmospheric distillation, which is made up of (a) vacuum distillation and (b) light ends recovery (gas processing). These steps of refinery separation processes separate these crude oil constituents into common boiling point fractions.

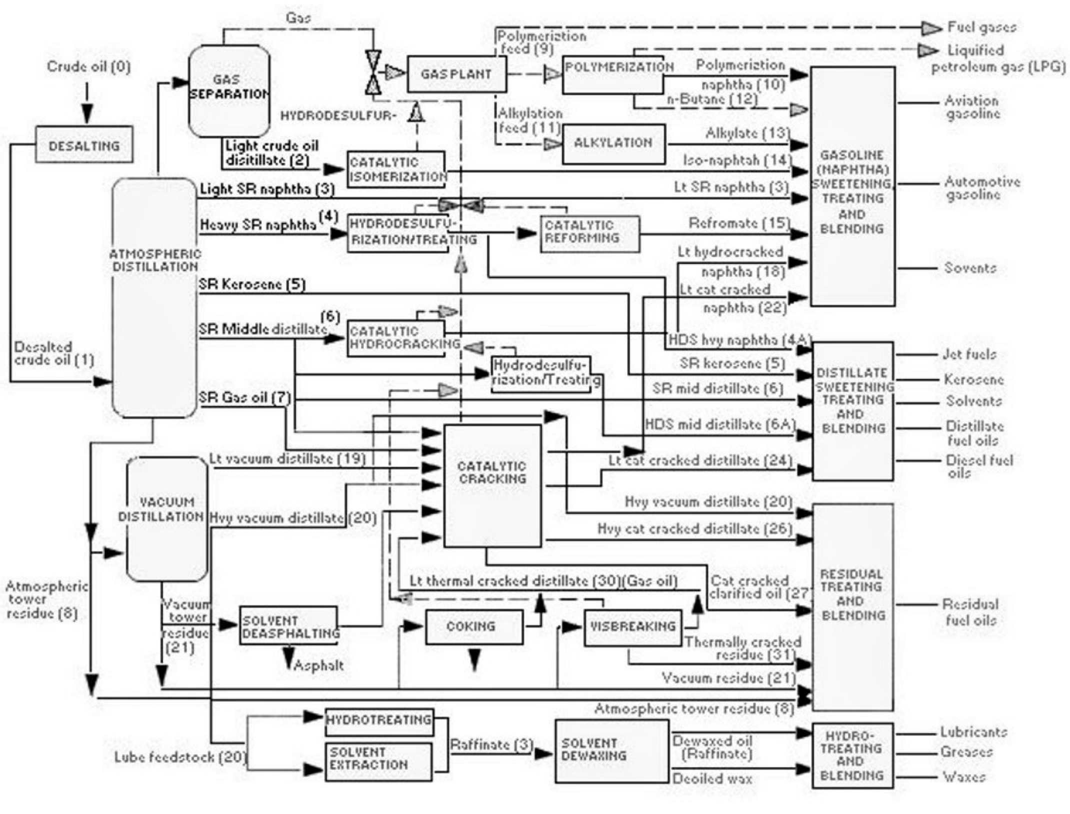
2. Petroleum conversion processes, encompassing cracking (thermal and catalytic), reforming, alkylation, polymerization, isomerization, coking, and visbreaking Cracking, coking, and visbreaking processes are used to break large petroleum molecules into smaller ones. Polymerization and alkylation processes are used to combine small petroleum molecules into larger ones. Isomerization and reforming processes are applied to rearinterval the structure of petroleum molecules to produce higher-value molecules of a similar molecular size.

3. Petroleum treating processes involving hydrodesulfurization, hydrotreating, chemical sweetening, acid gas removal, and deasphalting. The first 4 processes in this step removeundesirable elements such as sulfur, nitrogen, and oxygen. Deasphalting, is employed primarily for the separation of petroleum products.

4. Raw material and product handling comprises of storage, blending, loading, and unloading. These steps involve the logistical handling of the raw material and product.

5. Auxiliary facilities utilizing boilers, waste water treatment, hydrogen production, sulfur recovery plant, cooling towers, blow-down system, and compressor engines. All these auxiliary processes and equipments are necessary for crude oil refining as are they for collecting by-products.

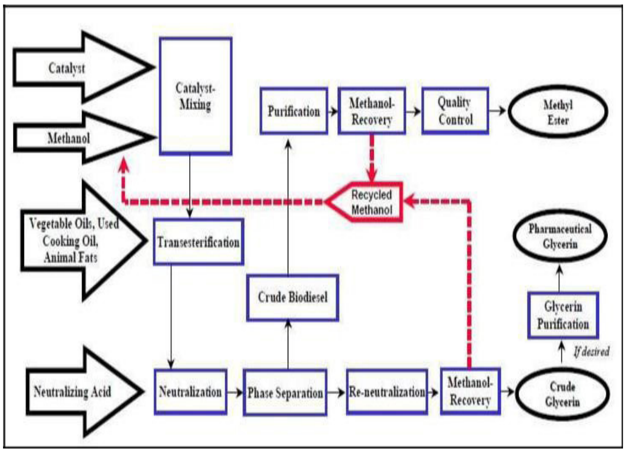
Figure 4 – Schematic of an example integrated petroleum refinery



Biocrude is made through transesterification of various vegetable oils. While first biocrude was made of peanut oil, the usage as a combustible energy source happened only after 1900 (Nitske and Wilson, 1965). Biocrude is quite simple to produce. It is made by chemically altering the molecular structure of any organic oil through the use of a chemical catalyst and an alcohol.

Technological innovations of the transesterification processes have led to improvements in efficiency in the production of biocrude. The source options for its production have changed and increased. The search for carbon neutral inputs makes the biocrude the importance of plant sources of raw material, such is vegetables, because they must not release more than the amount of carbon they have and planting them absorbs even more carbon. Their emissions produced are around 40 % of the fossil fuel ones (Stockmangrassfarmer.com). Biocrude is usually made of Virgin (vegetable) oil. Cooking oil recycled from restaurants can also be used to produce biocrude.

Figure 5 – Biocrude production process.



Source: National Biocrude Board.

The based catalyzed production of biocrude generally occurs using the following steps (National Biocrude Board)

- Mixing of alcohol and catalyst: The catalyst is typically sodium hydroxide (caustic soda) or potassium hydroxide (potash). It is dissolved in the alcohol using a standard agitator or mixer.
- Reaction: The alcohol/catalyst mix is then charged into a closed reaction vessel and the oil or fat is added. The system from here on is totally closed to the atmosphere to prevent the loss of alcohol. The reaction mix is kept just above the boiling point of the alcohol (around 65°C) to speed up the reaction. Excess alcohol is normally used to ensure complete conversion of the fat or oil to esters.
- Separation: Once the reaction is complete, two major products exist: Glycerin and Biocrude. Each has a substantial amount of the excess methanol that was used in the reaction. The reacted mixture is sometimes neutralized (if needed). The glycerin and biocrude can be separated by gravity with glycerin being drawn off the bottom of the vessel. A centrifuge can also be used.
- Alcohol Removal: Once both the products are separated, then the excess alcohol in each phase is removed with a flash evaporation process or distillation. It is then re – used.
- Glycerin Neutralization: The glycerin by-product contains unused catalyst and soaps that are neutralized with an acid and sent top storage as crude glycerin. In some cases, the salt formed during this phase is recovered for use as fertilizer. In more sophisticated operations, the glycerin is distilled to99% or higher purity and sold into the cosmetic and pharmaceutical markets.
- Methyl Ester Cleaning: When separated from the glycerin, the biocrude is usually purified by cleaning gently with hot water to remove residual catalyst or soaps, dried and sent to storage. In some processes, this step is not needed. This is normally the end of the production process resulting in a clear amber-yellow liquid with a viscosity similar to petro-diesel. In some systems, the biocrude is distilled in an additional step to remove small amounts of color bodies to produce a colorless biocrude.

Bio-fuels can be derived from various sources of raw material and each one has a different cost of production and also amount of energy inputs and outputs differ too. Depending on whether the product is ethanol or biocrude, it will always be compared to fossil fuels.

Table 1 – Relative Costs of Biofuels from Various Raw material

	Estimated cost per barrel of fuel
RAW MATERIAL	COST/Barrel
Cellulose	$305
Wheat	$125
Rapeseed	$123
Soybean	$122
Sugar beets	$100
Corn	$83
Sugar cane	$45
Jatropha	$43

Source: Goldman Sachs via Wall Street Journal (Aug 24, 2007)

Table 1 shows a comparison of various raw material which are used to obtain biofuels. It is clear that cellulosic ethanol is very expensive to produce, and that Jatrophae curcadis is the cheapest to produce among the alternatives. It is older source compared to nowadays when thesis is being written, but relative prices are still similar.

Bourne (2007) noted that if we use ethanol made from corn then we get 1.3 units of energy for a unit of fossil fuel energy invested. While for ethanol from sugarcane, for every unit of input of fossil fuel, 8 units of energy output can be produced. For biocrude in general, for every one unit of input of fossil fuel, 2.5 units of energy output can be produced. Whereas for cellulosic ethanol, for every one unit of fossil fuel input, 2-6 units of energy can be produced. In this case the variability due to various production methods. Finally, for biocrude from algae, it is still unknown, but estimated that 1000 sq. meters up to 5000 liters of biocrude every year.

Bourne (2007), adds that greenhouse gas emissions which accounts for the production and use of that particular fuel is promising for the bio-fuel candidates. Gasoline produces 20.4 pounds of carbon dioxide emissions per gallon of fuel [2.44 kg/l]. Corn ethanol emits.

16.2 pounds per gallon [1.94 kg/l] which is 22% lesser than gasoline, sugarcane ethanol emits 9 pounds per gallon [1,08 kg/l] which is 56% less, biocrude emits 7.6 pounds per gallon [910 g/l] which is 68% less, and finally cellulosic ethanol produces

1.9 [227 g/l] pounds per gallon, which is 91% less.

Bourne also adds that when gasoline was at the average price of $0.8 /l, Ethanol (E85) was at $0.7/l and that in order to get the equivalent amount of energy from a liter of gasoline, 5.33 liters of E85 would need to be consumed to get to dollar value to $0,98. Cane ethanol in order to match Brazil's average retail price of $1.3 per liter of gasoline with 25% ethanol mixed in, would require 4.77 liters of cane ethanol to produce the equivalent amount of energy which would bring the value to $1.03 which is still substantially lower than the gasoline-ethanol mix. In Germany, the biocrude was at same time comparably sold at a higher price than the fossil fuel diesel. In June 2007, the average price was $1.62 per liter of fossil fuel diesel and $1.8 for biocrude. To

To produce the equivalent amount of energy of 1 liter of fossil fuel diesel, 1.04 liters of biocrude is required at a value of $1.78.

The purpose of developing these products is to use them as fuel in internal combustion engines. But these engines are not well-suited for burning oil directly. The high viscosity of the oil causes coking of the injectors on the pistons and on the engine head which causes incomplete combustion of fuel. This leads to excessive carbon deposits on the pistons, eventually causing excessive wear on the engine. Therefore, the Jatrophae curcadis oil, like all the other oils, has to be processed into biocrude through the transesterification process discussed above.

There are three important variables to focus on in processing oil into diesel: flash point, caloric value and cloud point. For efficient energy release, the fuel must have a low flash point and cloud point and high caloric value. Table 2 illustrates the differences between fossil diesel and Jatrophae curcadis oil and biocrude, soybean biocrude, and palm oil biocrude. It shows that fossil diesel has higher caloric value, and the lowest flash and cloud point (except for soybean biocrude) compared to Jatrophae curcadis oil, Jatrophae curcadis biocrude, soybean biocrude and palm oil biocrude. However, Jatrophae curcadis biocrude is not too different from fossil diesel where the density, viscosity, and caloric value is very much similar. The cloud point is not too far off compared to fossil diesel while the flashpoint is 125°C higher. The implication is that Jatropha curcas oil can possibly replace fossil diesel and could also be blended with fossil diesel to have caloric value, cloud and flash point properties that are more suitable. The same can be said of soybean biocrude and palm oil biocrude. The conclusion here is that, all three sources of raw material, soybean, palm oil and Jatrophae curcadis are suitable replacements or complements for fossil diesel.

Table 2 – Fuel Properties of Jatrophae curcadis Oil, Jatrophae curcadis Biocrude and Fossil Diesel.

Properties	Jatrophae curcadis Oil	Jatropha curcas Biocrude	Soybean Biocrude	Palm Oil Biocrude	Fossil Diesel
Density, g/ml	0.920	0.865	0.880	0.870	0.841
Viscosity @	3.5	5.2	1.9 to 6	4.4	4.5
40^0C, Cst					
Calorific value,					
MJ/kg	39.7	39.2	32	37.8	42.0
Flash point, ^{0}C	240	175	130	182	50
Cloud point, ^{0}C	16	13	-1	15.2	9

Sources: Ramesh et al. (Jatrophae curcadis andfossil diesel), Mekalilie et al. (Soybean), and journeytoforever.org (Palm Oil)

Whether ethanol or biocrude is used, it is in nowadays view a move in the right direction. The proven warming climate and the persistent degradation of the living environment, offers us a choice to look at greener ways to power our engines. Hydro power has been used but is limited to many areas in the world. Solar and wind power has also been used and although getting popular, still quite expensive and also limited to only specific places around the world.

Anyway, the vast majority of our power plants and from the smallest of engines to the largest, fuel is still needed. Unfortunately, electricity batteries cannot be used everywhere. Bio-fuel is not going to completely substitute fossil fuel energy, at least this or next decade, but will definitely complement our current resources.

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БИООТЫНДЫ ШИКІЗАТТЫҚ ОТЫН КЕШЕНІМЕН САЛЫСТЫРМАЛЫ ТАЛДАУ

Аннотация. Биоотын мүмкін болашақта отын ретінде қарастырылады. Автокөліктерге арналған энергетика туралы айтатын болсақ, электр энергиясының әсерінен болатын «бәсекелестік» және қазіргі заманғы зерттеулердің арқасында танымалдылықтың артуы да сутегі болып табылады. Жалпы алғанда, биоотын қазіргі кезде Еуропалық Одақта, сондай-ақ Америка Құрама Штаттарында және әлемнің көптеген басқа аймақтарында белсенді қолдау табуда.

Мұнай-газ саласындағы белсенді басқару органикалық отын туралы ғана емес, сонымен қатар биоотын сияқты альтернативті отынның әртүрлі түрлері туралы білімді ескеруі керек. Бұл дипломдық жұмыстың мақсаты - Jatrophae curcadis (немесе «тазартқыш жаңғақ» деп те аталады) деп аталатын зауыттан алынатын био-шикі мұнай өндірісінің экономикасын талдау. Қазіргі уақытта ол Солтүстік Америка континентінің, әсіресе Мексика мен Оңтүстік Азияның субтропикалық аймақтарының айналасында өседі, тіпті Орталық Азияның құрғақ шөлдерінде аз өніммен өсе алады (құрғақ Малиде ол өсімдіктерден жабайы табиғат алып өседі). Бұл өте дәстүрлі емес өсімдік, сондықтан одан жасалған биоотын басқа биоотындармен салыстырғанда өте арзан болуы мүмкін.

Бұл зауытта өндірілген мұнай әлі тауар нарықтарында сатылмайды, бірақ болашақтың биоотыны ретінде қарастырылады, өйткені қазіргі уақытта сатылған соя майы мен пальма майы, менің талдауым бойынша, әлемнің көптеген бөліктерінде қымбатқа түседі. Өсімдік тұқымын (жаңғақты) биологиялық есепке дейін өңдеуге болатын био-шикі майға әкелу арқылы өндіру.

Экономикалық талдау көрсеткендей, жоғары тұқым өндіруге арналған өсімдіктерді суару және жақсы генетикалық іріктеу тұқымнан алынған биорент соя немесе пальма майының баламалы отындарымен бәсекеге түсе алады.

Түйін сөздер: Дизель, газ, менеджмент, экономикалық талдау, катрофалар, био-шикі мұнай.

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СРАВНИТЕЛЬНЫЙ АНАЛИЗ БИОТОПЛИВА С СЫРЬЕВЫМ ТОПЛИВНЫМ КОМПЛЕКСОМ

Аннотация. Биотопливо рассматривается как возможное топливо будущего. Что касается энергии для автомобилей, то интенсивная «конкуренция», вызванная электричеством, и рост популярности благодаря современным исследованиям также является водород. В целом, биотопливо в настоящее время активно поддерживается в Европейском союзе, а также в Соединенных Штатах Америки и во многих других регионах мира.

Активное управление в нефтегазовой отрасли должно учитывать знания не только о ископаемом топливе, но и о различных типах альтернативных видов топлива, таких как биотопливо. Целью этого тезиса является анализ экономики производства био-сырой нефти из растения под названием Jatrophae curcadis (или также известного как «гайка очистки»). В настоящее время оно растет вокруг субтропических регионов североамериканского континента, особенно в Мексике и Южной Азии, и с меньшей урожайностью может расти даже в засушливых пустынях Средней Азии (в засушливом Мали он выращивается для содержания дикой природы с растений). Это очень нетрадиционное растение, поэтому биотопливо, произведенное из него, может быть очень дешевым по сравнению с другими видами биотоплива.

Нефть, добываемая на этом заводе, еще не торгуется на товарных рынках, но рассматривается как биотопливо будущего, поскольку в настоящее время проданное соевое масло и пальмовое масло, по моему анализу, дороже во многих районах мира. Производство семян растений (орехов) при прессовании приводит к био-сырой нефти, которая может быть обработана до биоучета.

Тем самым, биотопливо является экономический выгодным для производства, а также что оно экологический чистый и безопасный для общества.

Экономический анализ показал, что при условии орошения и хорошего генетического отбора растений для получения более высокой продукции семян (цена на килограмм будет определяющим

фактором) биорента, полученная из семян, может успешно конкурировать с альтернативными видами топлива из сои или пальмы масла.

Ключевые слова: дизель, газ, менеджмент, экономический анализ, Jatrophae curcadis, био-сырая нефть.

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