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Techno-Economic on the Production of Aromatherapy Candles from Aetheric Oils

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Abstract (English)
The waste produced by oranges is orange peel which is still abundant, so making aromatherapy candles can have a good effect on the environment. This research aims to analyze the feasibility of a project to produce aromatherapy candles from aetheric oils on a large scale. Evaluation from an engineering perspective is determined by the evaluation of the initial factory design and stoichiometric calculations. Meanwhile, the evaluation from an economic perspective is determined by several parameters, such as Payback Period, Gross Profit Margin, Cumulative Net Present Value, etc. Based on the results of the analysis, the aromatherapy candle production project from aetheric oil can be scaled to industrial level and demonstrate a profitable project from a technical and economic perspective. This project also helps waste from sweet oranges (citrus sinensis), so that it can have a good effect on the environment and reduce accumulated waste. Based on this, this project is an innovative project so that it can compete with market standards. From the results of the economic evaluation analysis it can be concluded that this project is feasible to carry out.

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Key Words
Techno-Economic; Aromatherapy Candles; Aetheric Oils

Abstrak (Indonesia)
Limbah yang dihasilkan dari buah jeruk adalah kulit jeruk yang masih melimpah sehingga pembuatan lilin aromaterapi dapat memberikan dampak yang baik bagi lingkungan. Penelitian ini bertujuan untuk menganalisis kelayakan proyek produksi lilin aromaterapi dari minyak eterik dalam skala besar. Evaluasi dari sudut pandang teknik ditentukan oleh evaluasi desain awal pabrik dan perhitungan stoikiometri. Sedangkan penilaian dari segi ekonomi ditentukan oleh beberapa parameter seperti Payback Period, Gross Profit Margin, Cumulative Net Present Value, dll. Berdasarkan hasil analisis maka proyek produksi lilin aromaterapi dari minyak etherik dapat ditingkatkan skalanya menjadi tingkat industri dan menunjukkan proyek yang menguntungkan dari perspektif teknis dan ekonomi. Proyek ini juga membantu limbah dari jeruk manis (citrus sinensis), sehingga dapat memberikan dampak baik bagi lingkungan dan mengurangi tumpukan sampah. Berdasarkan hal tersebut, proyek ini merupakan proyek yang inovatif sehingga mampu bersaing dengan standar pasar. Dari hasil analisis evaluasi keekonomian dapat disimpulkan bahwa proyek ini layak untuk dilaksanakan.

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Introduction

Among this waste is organic waste, such as household waste, dry leaves, cloth made from natural fibers. This encourages many people to process this waste into more valuable items, such as using fruit peels and seeds from organic waste into something of value. One way to use fruit waste into something of value is the extraction of fruit peel essential oil (Astarini, 2010). One fruit peel that can be used is sweet orange peel (Citrus sinensis).

Orange fruit is a local fruit that is often found in Indonesia, especially the city of Surakarta.

Orange fruit itself can be processed into various types of preparations which are very useful. Sweet orange (Citrus sinensis) is a type of orange that is consumed by squeezing it to make a drink. So far, sweet orange peel (Citrus sinensis) has not been fully utilized and has become waste that is simply thrown away. Meanwhile, the peel of orange fruit contains useful ingredients, so orange peel can be processed into products that are useful for society (Kurniawan et al., 2017).

In sweet orange peel there are chemical compounds that can be utilized because they contain pectin and essential oil constituent groups. The essential oil components of sweet orange peel consist of limonene (95%), myrsen (2%), octanal (1%), decanal (0.4%), citronellal (0.1%), neral (0.1%) , geranial (0.1%), valensen (0.05%), sinnsial (0.02%), and sinensial (0.01%) (Alfianur, 2017). The limonene compound found in orange peel is what makes orange peel essential oil expensive because of its distinctive aroma. Therefore, orange peel will be very useful if extracted to obtain its essential oil.

Candles are a tool that can fulfill human needs. Apart from being a light, candles can also be used as home decoration and are a useful tool in assisting the therapy process and can support a modern healthy lifestyle. Nowadays, the function of candles is increasing, such as fragrances, which can be lit and spread a fragrant aroma throughout the room (Melviani et al., 2021). However, not many people know about aromatherapy candles, because their sales are still very rare, especially in areas far from big cities. Most aromatherapy candles are only sold in shopping centers with quite expensive prices and unattractive packaging. Even though many consumers want aromatherapy candles, considering that this product has many benefits for the body, apart from being relaxing, aromatherapy candles can also create a comfortable atmosphere, reduce stress, increase a person's energy, make sleep better and relieve mental fatigue and can help to form a pattern. Healthy living starts from home (Suyandhi, 2020).

Orange peel essential oil is often called aetheric oil. Orange essential oil can be used as an air freshener, perfume ingredient, and flavor enhancer in food. Orange essential oil is also beneficial for health, namely for aromatherapy. The aroma of oranges can stabilize the nervous system and create feelings of happiness. Because the essential oil content of orange peel produces an aroma that can stabilize the nervous system, aromatherapy products can be made. There are various forms of aromatherapy, namely, aromatherapy essential oils, aromatherapy incense, aromatherapy candles, aromatherapy massage oil, aromatherapy salts, and aromatherapy soap. In this research, the essential oils produced will be applied as aromatherapy candles. Aromatherapy candles made from sweet orange peel essential oil are very easy for people to use (Lestari et al., 2020).

Economic evaluation is one of the important points in building industrial chemicals. Some information from commercial sites was adopted to support engineering and economic analysis, such as chemical prices, components used, and equipment specifications (Shalahuddin et al., 2019). The aim of this analysis is to evaluate the possibility of producing aromatheraphy candles from aetheric oils on a large scale. This method was evaluated using two main perspectives of aromatherapy candles method and economic evaluation (Nandiyanto, 2018). Several parameters are calculated to support economic evaluation

- Gross Profit Margin (GPM) as a prediction in the calculation determines the level of profitability from economic conditions.
- Break Even Point (BEP) is a capacity calculation where the project does not benefit.
- Payback Period (PBP) is used to assume how long it will take for an investment to return the total initial capital spent.
- Cumulative Net Present Value (CNPV) is used to predict the condition of performance in a

function of annual production.
Below is shown the process of making aromatherapy candles from aetheric oil

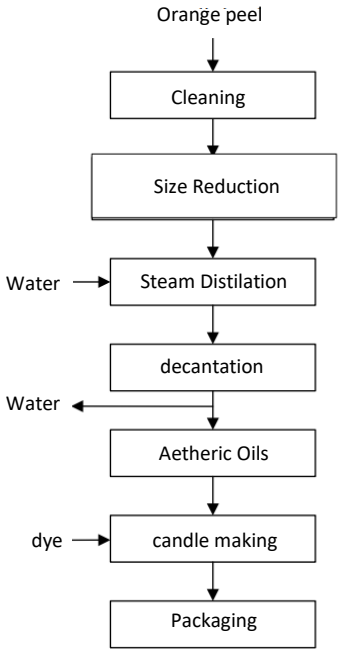

Figure 1 scheme of Aromatherapy candle production

Method

The method used is based on an analytical study of the prices of the materials used and the equipment. Material and tool specifications are sourced from an online website called alibaba.com. Data is processed using simple mathematical calculations and assisted by applications such as Microsoft Excel to obtain parameters for economic evaluation: GPM, BEP, PBP, and CNPV.

- GPM is a financial metric that indicates the percentage of revenue that exceeds the cost of goods sold (COGS). It is a key indicator of a company's profitability and efficiency in managing its production costs (Farris et al., 2010).

GPM = SR(S) is sales minus (R) raw materials

- PBP is a financial metric used to evaluate the time it takes for a company to recoup the initial investment in a project (Reniers et al., 2016). It was calculated based on the lifetime point when CNPV/TIC reaches zero.
- The Break-Even Point (BEP) was determined by dividing the aggregate fixed production costs by the difference between revenue per unit and variable cost per unit. (Nandiyanto et al., 2021).

- The Net Present Value (NPV) serves as a financial measure employed to assess the profitability of an investment or project. It signifies the disparity between the present value of incoming cash and outgoing cash over a specific duration, considering the time value of money. The NPV calculation entails discounting projected cash flows using a designated rate of return (the discount rate) and deducting the initial investment. A positive NPV suggests that the investment is anticipated to yield favorable returns and may be deemed worthwhile (Ferran & Ho, 2014).
- The CNPV percentage was determined by computing the present value of the annual total expenditure, while NPV could be derived by multiplying the cash flow by the discount factor (Nandiyanto et al., 2021).

Several factors are assumed to analyze some economic parameters:

- Analysis in US Dollars ($1= Rp. 15.501,-)
- Based on commercially available prices, the prices for paraffin 2,45 USD/kg, Stearic Acid 4,13 USD/kg, Dye 28,39 USD/kg. The price of the material written here is a price based on E-commerce.
- The total investment cost (TIC) was determined using the lang factor (Nandiyanto, 2018).
- The manufacturing process takes place on acquired premises or land. However, the acquisition of land for production is considered part of the initial expenses for industrial development. Profits from the investment in purchasing production land are expected to be realized once the project is operational.
- The process takes 8 hours to produce 50 pcs of aromatheraphy candles from aetheric oil. One day only allows one process cycle to take place.
- Delivery costs are borne by the buyer.

The project operation duration is 20 years.

Result and Discussion

Engineering Perspective

Viewed from an engineering perspective, the production of aromatherapy candles from aetheric oil can be scaled to industrial level. The total annual price for the raw materials required is 1,298.80 USD, with tool costs of 1,234 USD. **Figure 2** described total cost form Raw Materials, Labor, and Utilities. The raw materials for the production of 50 aromatherapy candles consist of 25 kg of orange peel from waste, 1.25 kg of paraffin, 0.415 kg of stearic acid, 0.005 kg of dye. The workers needed for this production require 2 people. The packaging used in this production is glass which costs 0.09 USD/pcs. Sales predictions within a year indicate a potential profit of 797,568.33 USD.

Given an anticipated project duration of roughly 20 years and achieving a payback period by the 4th year, including the lang factor in calculations, the Total installed Cost (TIC) needs to stay below 1,319.54 USD. Figure 2 described total cost form Raw Materials, Labor, and Utilities.

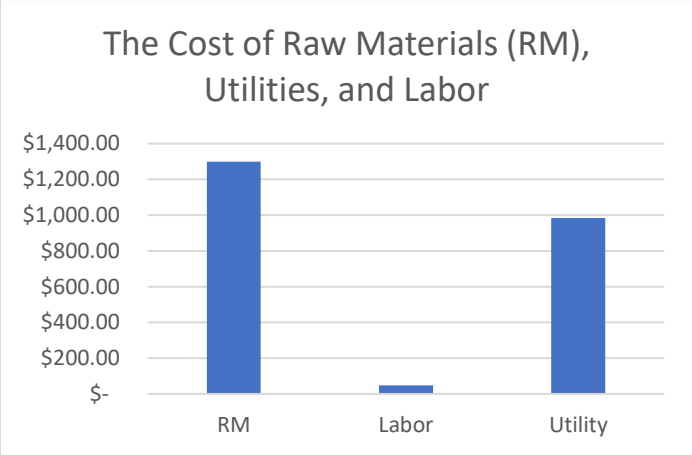

Figure 2 Cost of Raw Material, Labor, and utilities

Economic Evaluation

Figure 3 Explains the graph between CNPV/Investment for the production of aromatherapy candles from aetheric oils. This image shows that the ideal conditions that will be obtained in this production will be in the next 3 years. In the first to third years the graph shows a negative which explains that in that year the reduction in income was due to the initial capital costs required for this production. After 3 years of production the profits generated will increase up to the next 20 years, this shows the payback period (PBP). In table 1, the cumulative net present value/total investment cost is explained. It is shown that in the first year the two showed negative values but in the third year they changed to positive. Thus, it can be considered that the production of aromatherapy candles from aetheric oils is a profitable project because it requires a short time to cover investment costs.

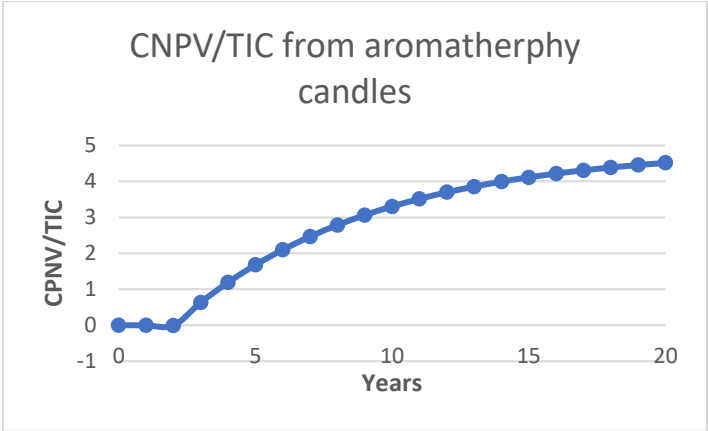

Figure 3 The CNPV/TIC under ideal condition

Table 1 Cumulative Net Present Value/Total Investment Cost

Year	CNPV/Investment
0	0
1	-0,000592
2	-0,0097465

3	0,632574693
4	1,191114843
5	1,676801931
6	2,099138528
7	2,466387744
8	2,785734887
9	3,063428056
10	3,304900376
11	3,514876307
12	3,697464073
13	3,856236043
14	3,994298626
15	4,114353046
16	4,218748194
17	4,309526583
18	4,388464313
19	4,457105817
20	4,516794082

The success of a project is also influenced by external factors. One of the external influencing factors is taxes provided by the state to finance various public expenditures. **Figure 4** shows a graph of cumulative net present value with some tax variations over 20 years. The graph explains that from the beginning of the year to the second year it shows the same results because CNPV is under tax variations and because of project development. CNPV in 20 years in several variations, namely 10, 25, 50, 75, 100%. The results of these variations show that the more taxes given, the resulting profits decrease. So taxes given above 50% will result in project failure.

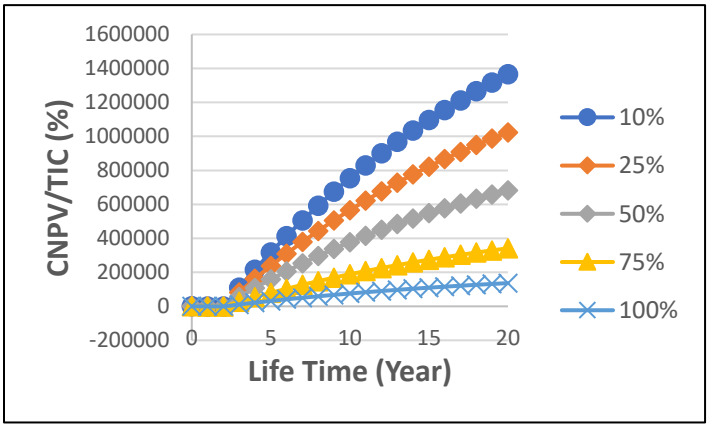

Figure 4 CNPV/Investment curve of tax variations.

Figure 5 shows a graph of the relationship between CNPV and several sales variations. The Y-axis is the cumulative net present value/total investment cost, and the X-axis is the lifetime (years). The sales variations used are 50, 75, 100, 125, 150%. The sales variations used in this

graph will show the more profits that will be obtained from the project being carried out. Based on this figure, it can be concluded that the greater the sales value obtained, the greater the profits obtained.

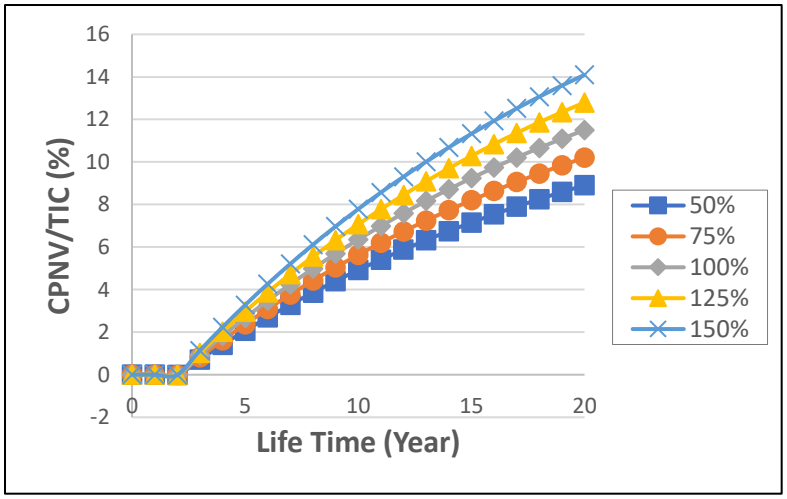

Figure 5 CNPV/Investment curve of sales variation

Conclusion

Based on the results of the analysis, the aromatherapy candle production project from aetheric oil can be scaled to industrial level and demonstrate a profitable project from a technical and economic perspective. This project also helps waste from sweet oranges (citrus sinensis), so that it can have a good effect on the environment and reduce accumulated waste. Based on this, this project is an innovative project so that it can compete with market standards. From the results of the economic evaluation analysis it can be concluded that this project is feasible to carry out.

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