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A Feasibility Study for Investment in Para Rubber Latex Foam Production for Combat Sport Mats in Thailand

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The purpose of this study was to investigate the feasibility for investment in Para rubber latex foam production for combat sport mats. The feasibility was evaluated in terms of the technique used and the production. The samples of this study were Para rubber latex foam processing factories, with different sizes, i.e., small, medium and large. Interviews with factories' executives and staff were conducted to gather information concerning the production processes. Study revealed that all three factories use Dunlop process to produce the Para rubber latex foam; however, the ratio between concentrated latex and chemicals were different, with 97% concentrated latex and 3% chemicals for large- and medium-sized factories, and 90% concentrated latex and 10% chemicals for small-sized factory. All three factories use steaming process to heat up the concentrated latex. From the production point of view, large-sized factory can readily produce combat sport mats because of the availability of larger moulds and steamers, whereas an assembly of smaller Para rubber latex foams was required to produce a combat sport mats for medium- and small-sized factories. Combat sport mats produced from latex foam in this study can be made in accordance with the standard issued by the Privileges and Standardization Division, Sports Authority of Thailand, which specified the characteristic of the mat as 1-meter wide, 2-meter long and 50-millimeter thick, with an ability to absorb shocks.

Keywords: Feasibility study, Para Rubber Latex Foam, Combat Sport Mat

Introduction

A Para rubber is a perennial plant known as important economic crop of Thailand with a lot of rubber products. In 2015, Thailand produced 4.47 million tons of natural rubber (Rubber Research Institute of Thailand, 2015). The most rubber consumption were export markets, which was higher than imports and

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its effect on the Para rubber price that mainly based on the foreign markets. Therefore, there were risky in terms of price fluctuation according to foreign markets. In the situation of fall on rubber prices, the government has a policy to push the public services to increase the use of rubber products (Sitthitool, 2016)

Para rubber foam is a product made by natural latex that characterize as spongy, and can be pressed or twisted without losing shape (Kajeonchaiyakul, 2005). Para rubber foam often used in the manufacture for load bearing product or impact bearing product. The study of the development of impact bearing product by natural rubber foam (Sukmak, 2009). Dunlop process as a technique for the production of natural rubber foam which was showed the properties of natural rubber foam base on adding Potassium Oleate to increase rubber sponge density. In addition, natural rubber foam was high density foam that can properly resist and prevent press. Natural rubber foam has potential to be used as impact bearing products.

A feasibility study is conducted to determine whether or not to invest in a project by considering technical, financial, economic, social and environmental issues (Piphatsithi, 2001). The scope of the feasibility study of this project was different term according to the type and appearance of the project and no need to study in every detail (Preyakorn, 2005). The feasibility study on technical issue is a study of data about steps in technical or knowledge. According to Atikah *et al.* (2014), Technology Readiness Level (TRL) was suggested to use in a feasibility study of technical issue on what level of system availability is available?, which was used by the National Science and Technology Development Agency (NSTDA). Moreover, Technology Readiness Level (TLR) was employed to assess the availability of technology.

At present, combat sports for instance Judo, Ju-jitsu, and Brazilian Jiu-jitsu used mats made from Para rubber latex foam production for impact barrier. These mats were popular among widely and competition management at various levels from basic to world class levels (Thadsanatanakorn, 2015). Para rubber foam is employed in combat sport mats; however, there are numerous alternative techniques to increase Para rubber foam products. For this reason, the researcher is interested in carrying out the feasibility study for investment in Para rubber foam production for combat sport mats in Thailand.

The objectives of this study were to conduct feasibility study for investment in Para rubber latex foam production for combat sport mats on technical, production, and finance aspects.

Materials and methods

In-depth interviews were used to elicit technical, production and finance aspect information for investment in the manufacturing of rubber foam cushioning for fighting sports. The steps of the study are presented as follows:

Population and samples

The populations used in this study are executives or staff involving in the rubber foam processing plants providing principal information. They were selected by specific methods from 3 sizes of the rubber foam processing plants, namely small size plant, medium size plant, and large size plant.

Data collection

1. Primary data were collected from in-depth interviews with key informants, i.e. executives or related staff from the rubber foam processing plants.
2. Secondary data were studied from documents, printed materials and researches related to the processing of rubber foam products.

Data analysis

1. In-depth interviews with key informants were analyzed for technical data of rubber foam product processing factories. In addition, validation of content from in-depth interviews was conducted by means of triangular data analysis and Technology Readiness Level (TRL) was employed to evaluate the feasibility as presented in Figure 1.
2. In-depth interviews with key informants were analyzed for manufacturing data of rubber foam product processing factories. Likewise, validation of content from in-depth interviews was obtained by triangular data analysis.
3. In-depth interviews with key informants on were analyzed for finance data of rubber foam product processing factories by using Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (B/C Ratio), Payback Periods (PB). Also, triangular data analysis was employed to validate the interview data.

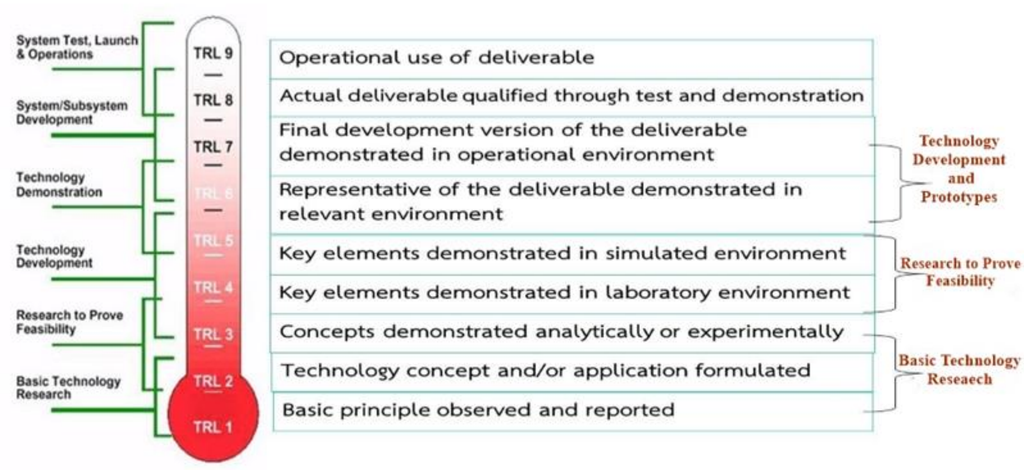

Figure 1. Technology Readiness Level (TRL)
Adopted from NSTDA (2017)

Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of a projected investment or project. It is calculated using Equation 1.

$$NPV = -C_0 + \sum_{i=1}^{T} \frac{C_i}{(1+r)^i} \qquad \text{(Equation 1)}$$

Where,
C_0 = Total initial investment costs
C_i = Net cash inflow during the period
r = Discount rate
T = Number of time periods
NPV > 0: Accept the investment.
NPV = 0: The investment is marginal
NPV < 0: Reject the investment.

Internal rate of return (IRR) is a metric used in capital budgeting measuring the profitability of potential investments. Internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero. It is calculated using Equation 2 (Jiwamit, 1999).

$$NPV = \sum_{t=1}^{n} \frac{B_{t-C_t}}{(1+r)^1} = 0 \qquad \text{(Equation 2)}$$

Where,
B = Net cash inflow during the period t
C = Total costs t
r = Discount rate
n = Number of time periods
t = Time

A benefit cost ratio (B/C Ratio) attempts to identify the relationship between the cost and benefits of a proposed project. It is calculated using Equation 3.

$$B/C = \frac{\sum_{t=1}^{n} \frac{CF_t}{(1+k)^n}}{I} \qquad \text{(Equation 3)}$$

Where,
CF_t = Net cash inflow during the period t
I = Total initial investment costs
k = Discount rate
n = Number of time periods

If a project has a B/C Ratio that is greater than 1, it indicates that the NPV of the project benefits outweigh the NPV of the costs. Therefore, the project should be considered if the value is significantly greater than 1. If the B/C Ratio is equal to 1, the ratio indicates that the NPV of expected profits equal the costs. If a project's B/C Ratio is less than 1, the project's costs outweigh the benefits and it should not to be an investment. (Jiwamit, 1999)

The payback period is the length of time required to recover the cost of an investment. The payback period of a given investment or project is an important determinant of whether to undertake the position or project, as longer payback periods are typically not desirable for investment positions. It is calculated using Equation 4 (Chotinuchittrakul, 2010).

$$Payback\ Period = \frac{Initial\ Investment}{Cash\ Inflow\ per\ Period} \qquad \text{(Equation 4)}$$

Results

Technical Aspect

Regarding the production of Para rubber foam from three factories sizes, Dunlop method was used in Para rubber latex foam production. The manufacturing process was divided into six steps as presented in Figure 2.

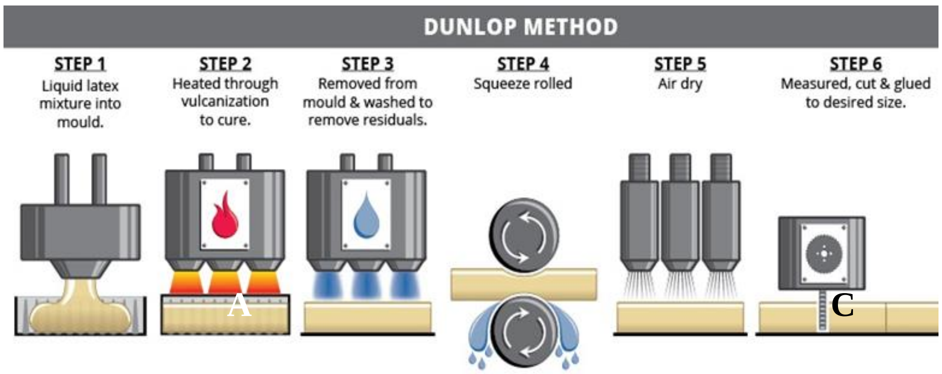

Figure 2. The Dunlop method
Source: Adopted from Laappoontanaarnan (2015)

Step 1: Liquid latex mixture into mould: latex are added to delayed-action gelling agents such as 10% Potassium-operate solution, 50% carbonate dispersion, 50% Sulphur dispersion, 50% Zinc Diethyldithiocarbamate dispersion, 50% Wing stay L dispersion, 50% Zing Oxide dispersion, 20% Diphenyl guanidine dispersion, and 20% Sodium Silicofluoride dispersion. Then, water is added to mix all components for 30 minutes per one mould to ensure that a component is adequately mixed. Properly mixed component can be noticed from the creamy characteristics of latex. The ratio of foam formed is defined as 97% latex and 90% chemical substance. These ratios are widely used in both large and midsize manufacturing companies, while small manufacturing companies used 90% latex and 10% chemicals substance.

Step 2: Heated trough vulcanization to cure: a chemical process for converting natural rubber and stabilize the final product by curing rubber in autoclave at 100 ℃ for approximately 20 minutes.

Step 3: Removed from mould and washed to remove residuals: latex is removed from mould by washing in water to wash out any residual curing agent for approximately 20 minutes.

Step 4: Squeeze rolled: latex foam is squeezed to remove water.

Step 5: Air dry: the products are dried in an air oven at 70 ℃ for 1 day for large manufacturing companies. Whilst, small manufacturing companies may need 2-3 days.

Step 6: Measured, cut and product to desired size: excess rubber is cut into desired sizes.

The rubber foam that produced according to the above formula has a density of 0.224 G/cm3. Based on evaluated the feasibility with ideas of Technology Readiness Level (TRL), the TRL4 is possible to use in production.

Production Aspect

In terms of the Para-rubber foam safety mat production for combat sports according to standard size of the Sports Authority of Thailand (SAT), the standard size was 1 meter width, 2 meter length, and 50 millimetre thick. Large manufacturing companies can produce rubber foam to the standard size because they have large moulds and steamers. On the other hand, the small and midsize manufacturing companies can produce rubber foam in smaller sizes due to small moulds and steamers. Consequently, the foam rubber safety mat production from small or middle size companies cannot meet with the standard size. The dimension that small or middle size companies can product is 0.50 meter width, 1 meter length, and 50 millimetre thick which requires four rubber foams to be assembled to the standard size of foam rubber safety mat that properly for using in combat sports. Finally, the products of Para rubber latex foam are covered with PVC leather.

Financial Aspect

Regarding the investment in Para rubber foam for safety mat production for combat sports, financial analysis was conducted by using investment production with one set of production equipment: vortex mixture, and steamer, oven. The study revealed that initial investment of Para rubber foam factory was 1.5 million Baht and Latex concentrate was used for productions more than 25,920 litres per year. This production volume can be production of Para rubber foam safety mats at 1,800 sheets per year and generate net income at 1.33 million Baht. There was a straight-line method to calculate depreciation. Machinery and equipment were calculated depreciation for 5 years without salvage value. Buildings and structures were calculated depreciation for 10 years, and then discounted to present values at 10 %.

Table 1. Net income

Year 1	Year 2	Year 3	Year 4	Year 5
1,334,395	1,334,395	1,334,395	1,334,395	1,334,395

Table 2. Financial indicators

Discount rate	NPV (Baht)	IRR	B/C Ratio	PP (years)
10%	3,558,406.91	84.84%	3.37	1.1

Net Present Value (NPV) was 3.5 million Baht. Internal Rate of Return (IRR) was at 84.84% with the ratio 10% Benefit-Cost Ratio (B/C Ratio) at 3.37 fold, and Payback Periods (PB) was at one year and one month. The results of the feasibility study of Para rubber latex foam production for combat sport mats are found to be satisfactory for investment.

Conclusion

Regarding the feasibility study on investment production of Para-rubber foam safety mat products for combat sports, Dunlop process was employed as a technique for the production of natural rubber foam. TRL4 was used to increase technical feasibility for production, while TRL9 was used to study in financial and the ability to create prototypes in the field that related to identity of Atikah *et al.* (2004) that is “To continue the process of commercialization of the technology developed to TRLs 9, the further research recommended doing a deeper study concerning technical of the Li-ion battery technology. In addition, it is recommended also to conduct the market study and economic feasibility”.

The feasibility of Para rubber foam safety mat production for combat sports in the standard size for products was 1 meter width, 2 meter length, and 50 millimetre thick. Para rubber mat products should be tests in real working condition (TRL7) in field test prototype with athletes who are direct consumers. In regard to the financial feasibility of the Para-rubber foam safety mat production for combat sports from TRL9, the result exposed that the financial feasibility of the project was the period of 5 years. The initial investment of the project was 1.5 million Baht, 10% of interest rate or discount rate of 10% and can finish payback period in one year and one month. The Net Present Value (NPV) was 3,558,406.91 Thai Baht. The Internal Rate of Return (IRR) was 84.84%, which was more than 10% of discount rate revealing that the yield of project gained a worthwhile return on investment. Moreover, Benefit-Cost Ratio (B /C Ratio) was 3.37 fold. The results exhibited that investment of Para rubber foam safety mat production was possible and satisfactory for investment.

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