

ZEOLITES CATALYST FROM OIL PALM ASH
FOR PETROCHEMICAL INDUSTRIES

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MASTER OF CHEMICAL ENGINEERING WITH
ENTREPRENEURSHIP

UNIVERSITY MALAYSIA PAHANG

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INDUSTRIES

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LIST OF ABBREVIATIONS

EPA	United States Environmental Protection Agency
FCC	Fluid Catalytic Cracking
FELDA	Federal Land Development Authority
KG	Kilogram
PETRONAS	Petroleum Nasional Berhad
RM	Ringgit Malaysia
UMP	Universiti Malaysia Pahang
USD	United States Dollar
UTM	Universiti Teknologi Malaysia

EXECUTIVE SUMMARY

The nature of business is the application of “Waste to Wealth” concept which is converting industrial waste into a valuable product. The industrial waste can be converted and become an added value product to a certain industries. The product that we are producing is zeolites catalysts for petrochemical industries using oil palm ash. The synthesis of zeolites using oil palm ash will be more environmental friendly. It’s also will increase the performance of the zeolites in the process. Besides that, synthesis of zeolite using chemical would be very expensive compare to what we have here, a waste as main composition of silica that is used to replace some of the usage of chemical. The present market for Malaysia is about 9000 metric tons per annum. About five detergent manufacturers and three oil and gas companies are users of zeolite A. However, a large number of companies and petrochemical industries in Malaysia are potential users or currently using imported zeolites. This is the opportunities to start a company that produce zeolite in Malaysia. The location for this business is in Gebeng, Pahang because of the availability of raw material and also located at the centre of petrochemical industry in Malaysia which is in Pahang and Terengganu. The purpose of this business plan is to obtain capital for starting-up this company. The total capital needed for the start-up of this company is RM 1,200,000. This includes all equipment and others fixed assets such as a warehouse for operation location, the renovation, furniture and electric appliances such as computers and so forth. From the financial analysis we are be able to have return on investment in the third year of business. Based on the analysis conducted which comprises of market analysis and financial analysis mostly, this business has the potential to grow in Malaysia.

CHAPTER 1

INTRODUCTION

1.1 PRODUCT OVERVIEW

Zeolites are known for its good environment effect. The usage of zeolite whether it is natural zeolite or synthetics zeolites, both have a very good effect on environment. The processes that use zeolite would have the green effect. So, the zeolites itself is a good product to be commercialize.

Our product unique selling proposition is that we are using waste to give silica and aluminium content of the zeolites. The usual sources of aluminium are aluminium hydroxide, aluminium isopropoxide, and sodium aluminate or alumina sols of different concentrations. Amorphous silica, sodium silicate, sodium metasilicate, silica glass, silicic acids and various concentrations of silica sols are common silicon source used (Endud, 2007). The usage of chemical would give a higher production cost in producing zeolites. As there are abundant of oil palm ash in the oil palm industries, this is one of the ways to utilize the waste and reduce the waste produce in Malaysia.

Oil palm ash have chemical composition of the chemical elements of oil palm ash are found to be silicon dioxide, aluminium oxide, iron oxide, calcium oxide, magnesium oxide, sodium oxide, potassium oxide and sulphur trioxide (Nurdin, 2010). The composition of 40% silicon oxide and 6% aluminium oxide are important in the synthesis of zeolites.

1.2 MARKET OVERVIEW

In Malaysia, there are no zeolites producer/manufactures. Most of zeolites supplies are imported from other country such as China. So, the market in Malaysia is available to be explored by the new venture of producing zeolite catalyst. The zeolite market is growing because of its application in industries are varies. Zeolite market is segmented based on quality (Vermeiren et al, 2009). Synthetic zeolite does not have the good quality as our zeolite because of the silica elements from the oil palm ash is known to be the best. Our competitors are the distributors of synthetic zeolite imported from other country. Other than that, our competitors would be a spin-off company of Universiti Teknologi Malaysia (UTM) that doing research and development of zeolites using rice husk.

1.3 RESOURCES AND RAW MATERIAL

Most important factors in maintaining the business is to secure the supplies of raw material which is the oil palm ash from oil palm mill. As oil palm mill can be found in most of the part in Malaysia, it is not a problem in obtaining the raw material. Our main resource of raw material would be FELDA which is the biggest oil palm company in Malaysia.

Oil palm ash is a by-product obtained from a small power plant, which uses the palm fibre, shells and empty fruit bunches as a fuel and burnt at 800-1000°C. The main chemical composition of oil palm ash is silica which is have great similarities with the raw materials typically used in the manufacture of zeolites. The reasons for using this source as the starting materials in production of zeolites are because they are cheap and available in bulk quantities. Oil palm ashes are currently under-utilized, have high workability, and require less water (or solution) for activation. The production of zeolites using oil palm ash also as a resource constitutes one important solution of waste management.



Figure 1.1 Palm oil residues



Figure 1.2 Oil palm ashes

CHAPTER 2

MARKET ANALYSIS

2.1 INTERNATIONAL/REGIONAL/LOCAL INDUSTRY

2.1.1 Zeolite consumption

Zeolites have a very large global consumption of nearly 4 million metric tons per annum. The global consumption of natural zeolites is projected to grow to 4.58 million metric tons per annum by 2005 (Vermeiren et al, 2009). The commercially significant zeolites are synthetic and manufactured hydrothermally. With great demand for commercial applications, zeolites are produced in large quantities as detergent builders, petroleum refining and petrochemical processing catalysts and a variety of adsorbents or molecular sieves in treatment of nuclear waste and extraction of ammonium ions from municipal waste water.

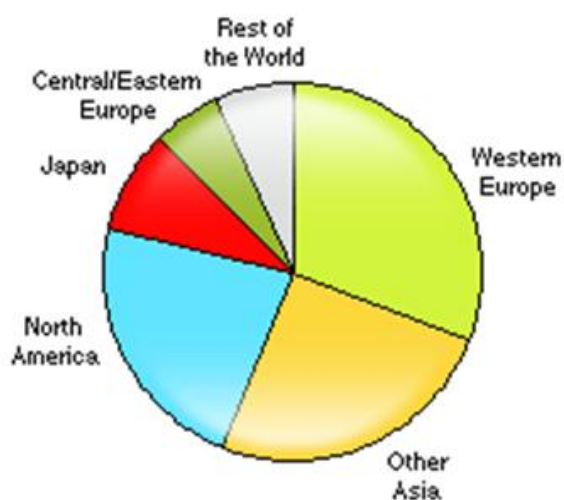


Figure 2.1 World consumption of zeolites

The consumption of synthetic zeolites is estimated to be 1.36 million metric tons per annum and is expected to reach to 1.61 million metric tons per annum by the year 2005. The overall consumption of zeolites is expected to rise from the current 5.34 million tons per annum to 6.19 million tons per annum by 2005. The value of the market is estimated to be USD2.15 billion at present, rising to USD2.52 billion by 2005 (Vermeiren et al, 2009).

Table 2.1 Global consumption of Zeolites based on type in 2000

Zeolite type	Consumption in thousands of metric tons per annum				Total
	United States	Western Europe	Japan	Other Global Regions	
Natural zeolites	32	30	120	3800	3982
Synthetics zeolites	470	606	110	176	1362
Detergents	365	555	95	145	1160 (85%)
Catalysts	70	26	10	11	117 (8%)
Adsorbents	35	25	5	20	85 (7%)
Total	502	636	230	3976	5344

Sources: Vermeiren and Gilson (2009)

In the Asia-Pacific region excluding Japan, the total demand for synthetic zeolites is estimated to be around 160,000 metric tons per annum. Major countries are Korea (85,000 metric tons per annum), Thailand (40,000 metric tons per annum), China (13,000 metric tons per annum) and India (12,000 metric tons per annum). The present Malaysian market size is about 9000 metric tons per annum (Hamdan, 2003). About five detergent manufacturers and three oil and gas companies are believed to be users of

zeolite A. However, a large number of companies and petrochemical industries in Malaysia are potential users or currently using imported zeolites.

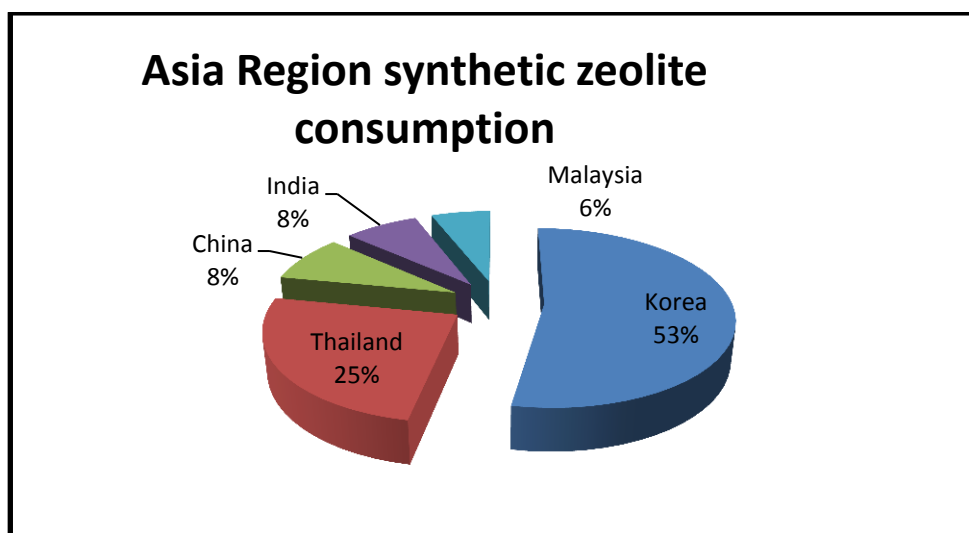


Figure 2.2 Zeolite consumption in Asia region

Table 2.2 Zeolite market share and growth based on type

Zeolite consumption/supply (kta)	2001	2004	2004 share (%)		Growth (%)
			Volume	Value	
Synthetic zeolites consumption					
Detergent builder	1188	1325	78.2	56	11.5
Catalysts	184	241	14.2	27	30.9
Adsorbents/desiccants	92	126	7.4	17	36.9
Total	1464	1692			15.6
Synthetic zeolites capacity	1926	2029			5.3
Natural zeolites consumption	>3100	>2500			-19.3
Natural zeolites production	3293	2557			-22.3

Sources: Vermeiren and Gilson (2009)

From table 2.2, the growth rate decrease means that the industries still do not have enough production to fulfil demands. As the demands are increasing but the growth of production is still not enough there is a market possibility to enter.

2.1.2 Market Segment Zeolites for Petrochemical Industry

In petrochemical industry, zeolites are manufactured as catalyst. This production of catalyst is already a sizeable and growing activity. It is generally segmented into few market segments which are refining, environmental, polymer and chemicals. While the environmental catalyst market is growing fast, refining and petrochemicals are presently stable or slightly declining in relative terms. Environmental catalysts constitute the largest catalyst market and its share will grow to over 30% in 2011. The market size of refinery catalysts is still rising and at a higher pace than the demand growth of refined products.

Table 2.3 Zeolites for Petrochemical market segment

Market segment	2005		2008		2011	
	10 ⁶ \$	Share (%)	10 ⁶ \$	Share (%)	10 ⁶ \$	Share (%)
Refining	2693	19.4	2929	18.4	3242	18.5
Environmental	4404	31.7	5393	33.9	5871	33.5
Polymers	2959	21.3	3472	21.8	3938	22.5
Fine chemicals, intermediates	1350	9.7	1430	9.0	1515	8.6
Petrochemicals	2475	17.8	2701	17.0	2951	16.8
Total market [10 ⁶ \$]	13881		15925		17517	

Sources: Vermeiren and Gilson (2009)

2.2 TARGET MARKET INFORMATION

In Malaysia, our customers are based on Petrochemicals Company and also Refinery Company which are usually under the same management. These are some examples of Petrochemicals Company in Malaysia.

- PETRONAS
- Shell
- ExxonMobil



Figure 2.3 Major Petrochemical Company in Malaysia

2.3 COMPETITORS EVALUATION

In Malaysia, there are no zeolites producer/manufactures. Most of zeolites supplies are imported from other country such as China. There are some company that act as distributors in Malaysia. These companies could be the competitors but also could become our product distributors in Malaysia or other's company. Globally, there are many major synthetic zeolite producers. Some are pure zeolite manufacturers for one or two applications, pure catalyst manufacturers, business units of large chemical or oil companies while others competitors are either process licensors involved in the catalyst manufacturing or suppliers of finished catalysts through joint-venture.

There is one spin-off company of Universiti Teknologi Malaysia (UTM) that are doing research and development of zeolites using rice husk. Gelanggang Kencana Sdn. Bhd. is not producing zeolites for commercialization but more of research and development. The company also in a process of building their pilot plant in the future. So, this company could be our major competitor in the industry.

Table 2.4 Major synthetic zeolite producers

Major synthetic zeolite producers	Application			
	FCC	Detergent	Adsorbent/desiccant	Specialties
Albemarle, including former Akzo	X	X		X
BASF (former Engelhard) Catalyst&Chemical Industries	X			X
Ceca			X	X
ExxonMobil				X
Industrial Zeolites	X	X		
Instituto Mexicano Del Petroleo	X			
MAL			X	
Mizusawa Ind. Chem.		X	X	
OAQ Salavantnefteorgsintez	X			
PQ/Zeolyst/Ineos Silica		X	X	X
Shandong Aluminium Corporation		X		
Sinopec (RIPP)	X			X
Süd-Chemie, including Tricat			X	X
Tosoh		X	X	X
Uetikon/Zeochem			X	
UOP			X	X
W. R. Grace & Co	X		X	X

Sources: Vermeiren and Gilson (2009)

CHAPTER 3

COMPANY DESCRIPTION

3.1 NATURE OF BUSINESS

Zeolight Sdn. Bhd. is a pilot plant company that produces zeolite catalyst from oil palm ash. This pilot plant company is a new venture that will be located in Gebeng, Pahang. This company is an idea from team of researcher in University Malaysia Pahang. The research conducted to obtain zeolite catalyst using waste material which is oil palm ash is succeed with good result of industrial compatibility.

Our vision is;

“To become number one manufacture for zeolite catalyst made from waste material in Malaysia”

Our mission is;

“To provide the best quality zeolite catalyst made from oil palm waste”

These are our company objectives;

- To become pioneer in zeolite catalyst industry in Malaysia
- To provides high quality products and achieve our annually targeted sales.
- To have a healthy and safe working environment that applies safety standard.

The nature of business is the application of “Waste to Wealth” concept which is converting industrial waste into a valuable product. The industrial waste can be converted and become an added value product to a certain industries. The product is zeolite made from oil palm ash. To minimize the solid waste, it is best to recycle the waste and turn it into a valuable product. The waste to wealth concept is applied as oil palm waste (solid waste) can be used to produce zeolites that have so many commercial values.

The main point is that synthesis zeolite from oil palm ash is very much saving cost. The chemical synthesis zeolite has a very expensive production cost. This is a good opportunity to set up a business on this. Besides that, most of zeolite catalysts that are used in Malaysia’s industry are imported from other country like China, Indonesia and Australia. We can see that this is a very good opportunity to have locally produce zeolite that could reduce their cost in buying zeolites from outside.

3.2 ORGANIZATION AND MANAGEMENT

Zeolight Sdn. Bhd. is company with the early member of two people. In addition, we have one advisor for our company that helps with the company start-up and management.

Advisor

Name: YH. Profesor Dato' Dr. Rosli bin Mohd Yunus; DIMP.

Position: Deputy Vice-Chancellor (Research & Innovation) UMP, Senior Lecturer in Faculty of Chemical Engineering and Natural Resources, UMP

Education Background: Ph.D. (Wales), M.Sc. (Wales), B.Sc. (North Carolina State), Dip. (ITM)

Key Responsibilities: Prof. Dato' Dr. Rosli will act as an advisor for this company. This is because he is the deputy Vice-Chancellor of Research & Innovation in UMP. The research of producing zeolite from waste is under his supervision and he would like to make this research into business venture. With his experiences in developing business from research will help us in providing the information about business and advise us about our business from many important aspects.

Team Leader (Owner)

Name: Dr. Ir. Said Nurdin

Position: Senior Lecturer in Faculty of Chemical Engineering and Natural Resources, UMP and Head of Researcher for Process Safety and Environment research group, UMP.

Education Background: PhD (Env. Chem. Eng.), Univ. of Padernborn (Germany), Ir. (B. Sc.) (Chem. Eng.), ITS, Surabaya, Indonesia

Key Responsibilities: In this company, Dr. Ir. Said Nurdin is the owner and the team leader. He is the leader of the research team for production of zeolite from oil palm ash. With his research we are able to form the team for executing this research project into a business venture. He will provide the information related to the technologies we are using for this business. Besides that, the technical and chemical part of this business is also under his supervision.

Team Member (Partner)

Name: Noor Atikah binti Mohd Badruddin

Position: Master student in UMP

Education Background: B.Eng of Chemical Engineering (UMP); M.Sc of Chemical Engineering with Entrepreneurship (UMP).

Key Responsibilities: In this company, Noor Atikah is one of the management team member and also business partner. She will provide the information related to business management with knowledge of chemical engineering background. Her role is to make sure the business plan is success and be able to provide the information about the marketing and financial for investment fund. Business management is under her key responsibilities. With knowledge of Chemical Engineering and also entrepreneurship studies, she will help to build up this business.

The company will employ 15 employees including from administration and also operation section. Below is the organization chart for Zeolight Sdn. Bhd. The chart does not include the general workers for operation section.

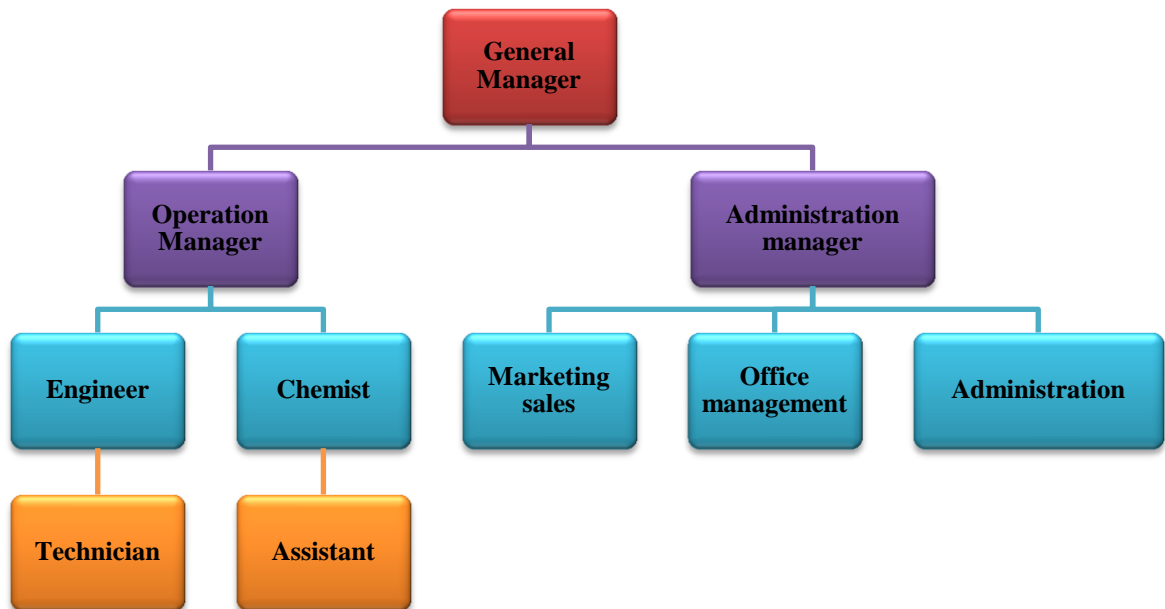


Figure 3.1 Organization Chart for Zeolight Sdn. Bhd.

3.3 LOCATION OF OPERATION

The suitable place to set up this pilot plant could be anywhere. To have more advantages in reducing the production and transportation cost, the pilot plant can be built near to the raw material which is oil palm mill. Since oil palm mill is almost everywhere in Malaysia because we are the biggest palm oil producer in the world, the location should not be a problem. The best location is in Pahang, because here in Pahang we have plenty of oil palm mills and also it is the centre for petrochemical industries that mostly in Gebeng, Kuantan and Kerteh, Terengganu. It is convenient for us to receive raw material and distribute the product. It is also near to research area (University Malaysia Pahang).

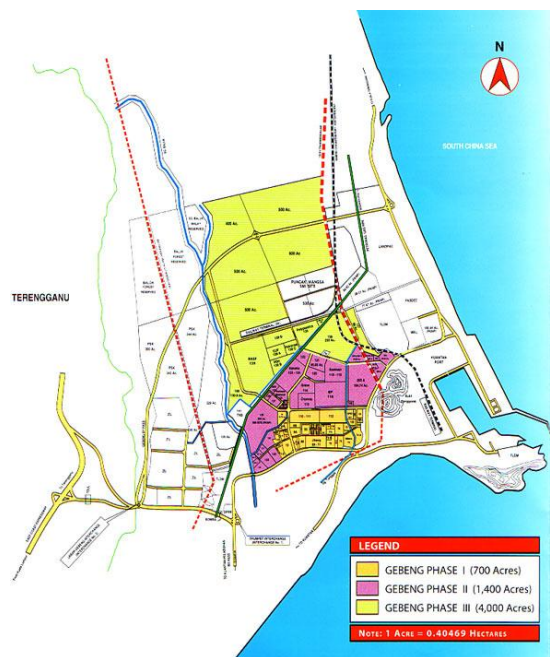


Figure 3.2 Gebeng Industrial area map