

Chapter 1

Preface

**1.1 Background**

During the past 5 years, Thailand has imported a lot of faucet from the other countries. The value of import faucet during the year 1993-1997 is shown in the below table.

Table 1 Value of Import faucet during the year 1993-1997.

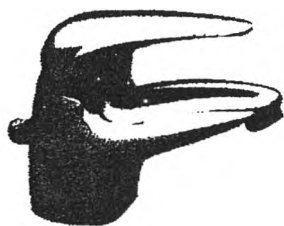
Year	1993	1994	1995	1996	1997
C.I.F. Value (Mil. Baht)	300	397	435	350	342

Source: The Customs Department of Thailand.

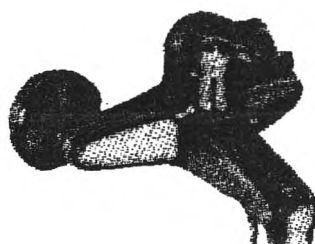
An increasing in demand of import faucet during the past five years reflects that local-made faucets are not fully satisfy the needs of Thai people, therefore there are several importers imported the faucets to serve the demand of these people.

After looking at the current market, it is noticeable that almost of import faucets are in form of single lever mixers. Consequently, a study on an optimum capacity for setting up a single lever mixer factory in Thailand should be studied in order to be the information for investors.

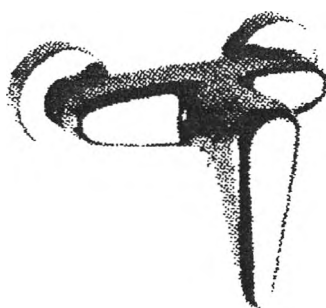
Figure 1 Single-lever mixers



Single lever mixer for wash basin



Single lever mixer for bathtub



Single lever mixer for shower

Figure 2 Import value of faucets during the year 1993-1997

(Source: The Customs Department of Thailand)

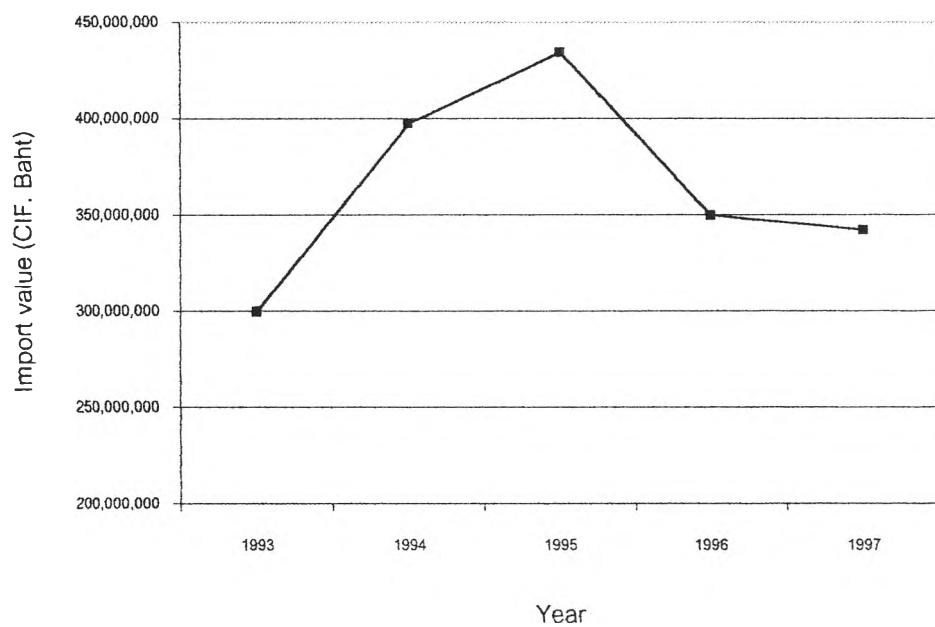


Table 2 Import faucet classified by country of origin during 1993-1997.

Countries	1993	1994	1995	1996	1997
U.ARAB EMIRATES			16,752		98,252
AGENTINA			7,302		
AUSTRIA	151,569	578,676	534,203	1,841,931	309,673
AUSTRALIA	3,658,904	270,156	1,569,859	182,844	270,735
BELGIUM	56,457	140,784	45,982		219,551
BALGALIA			943,914	9,649,138	119,863
BRAZIL				830,216	
BRUNEI			34,473		
CANADA	1,749,014	13,669	81,472		
SWITZERLAND	403,749	529,302	782,115	2,632,679	1,656,899
CHINA	22,691,513	38,627,138	51,534,282	24,174,450	47,366,334
CZECH		4,046	22,891		
GERMANY	72,298,115	90,652,769	88,565,039	98,911,230	104,781,423
DENMARK	1,455,781	1,219,281	3,959,788	2,435,840	4,913,766
EGYPT			292,642	2,928,985	
DOMANICA		221,853			
SPAIN	717,710	1,055,340	1,825,793	4,922,099	3,731,522
FINLAND	562,220	31,044		63,215	15,482,824
FRANCE	1,257,843	1,947,826	17,029,622	9,026,304	5,157,553
UK	1,076,189	2,370,008	723,610	2,991,638	1,186,390
GHANA		94,951			
HONGKONG	2,838	4,756	1,363	493,257	37,967
HANGARY					174,530
INDONESIA	518	34,773			2,165,377
ISARAEAL	1,401,103	1,284,330	359,968	31,277	29,503
INDIA	1,157,700	451,302	35,919	482,719	365,750
IRAN				121,627	
ITALY	47,158,963	72,148,501	83,646,446	71,834,367	64,965,302
JAPAN	90,957,418	112,599,189	107,681,684	48,417,484	48,061,000
KOREA	5,563,484	15,498,732	5,498,500	3,150,977	988,193
LITHUNIA	29,859		110,777		
MALAYSIA	2,781,983	5,532,179	2,820,549	554,625	1,507,678
NETHERLAND	1,513,195	3,116,090	298,188	338,583	111,590
NORWAY	456	23,869	17,098	42,552	
NEWZEALAND			1,880,331	197,681	
PAKISTAN				130,457	
PHILIPPINES				199,569	3,341,763
POLAND	88,558		112,207	144,946	176,394
RUSSIAN			58,960		
SWEDEN	1,442,533	627,208	22,448	667,353	68,113
SINGAPORE	335,371	765,279	978,975	501,702	4,224,430
TURKEY				2,885	
TAIWAN	6,565,819	7,088,497	9,368,108	9,857,835	7,152,367
USA	34,717,329	40,469,777	53,716,790	52,016,511	23,523,879
Total CIF baht.	299,796,191	397,401,325	434,578,050	349,776,976	342,188,621

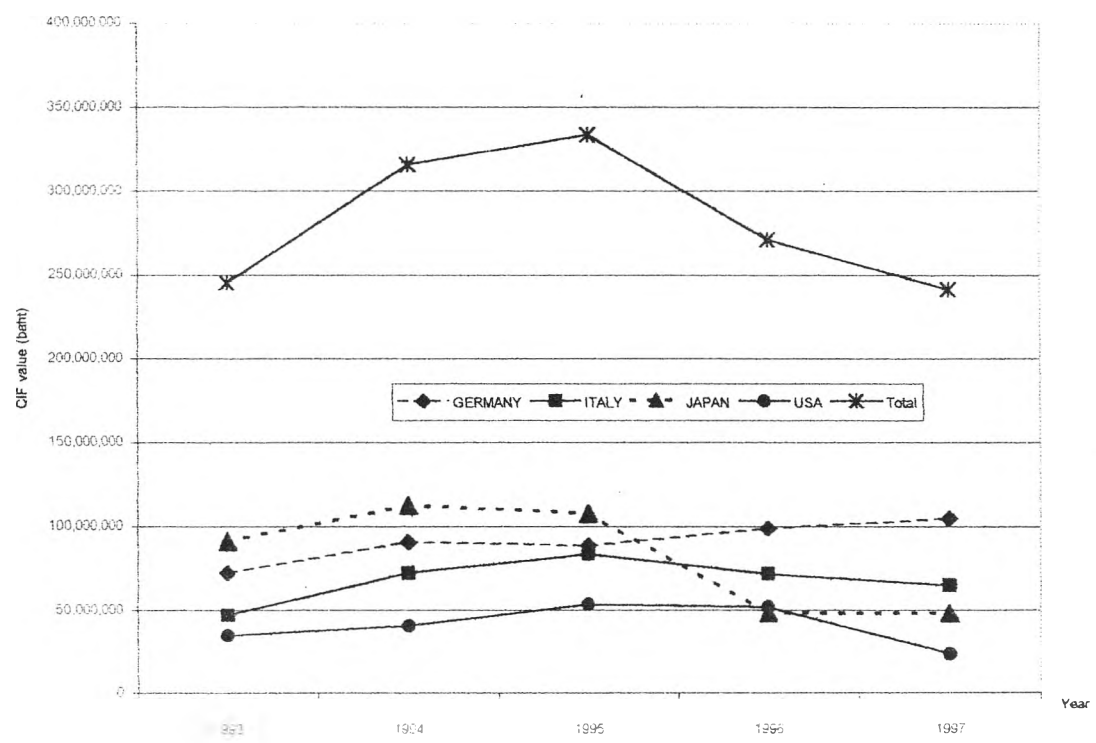
Source: The Customs Department of Thailand

Table 3 Major-sources of import faucet during the year 1993-1997

Source: The Customs Department of Thailand

Countries	1993	1994	1995	1996	1997
GERMANY	72,298,115	90,652,769	88,565,039	98,911,230	104,781,423
ITALY	47,158,963	72,148,501	83,646,446	71,834,367	64,965,302
JAPAN	90,957,418	112,599,189	107,681,684	48,417,484	48,061,000
USA	34,717,329	40,469,777	53,716,790	52,016,511	23,523,879
Total	245,131,825	315,870,236	333,609,959	271,179,592	241,331,604
Total import faucet from all sources	299,796,191	397,401,325	434,578,050	349,776,976	342,188,621
Percentage of import faucet from major sources	82%	79%	77%	78%	71%

Figure 3 Major sources of import faucet during the year 1993-1997



1.2 Objectives

- To forecast the demand of single lever mixer for the next 6 years (1998-2003).
- To propose the most suitable production process and raw material for making a single lever mixer.
- To determine the optimal capacity for setting up a single lever mixer factory.
- To evaluate the financial returns after setting up a single lever mixer factory

1.3 Scope

- The thesis studies only the production of single lever mixer.
- The study does not include design stage.

1.4 Expected benefits

- To be a guideline for setting up a factory to produce single-lever mixer in order to reduce the value of import faucet.
- To be an alternative for the existing importers in order to obtain the lower cost of product by setting up their own factories.

1.5 Procedure of the study

1. Study on relevant document, researches, theses, and textbooks.
2. Collect data and relevant information such as import value, production processes, industrial standard, materials, machines, etc.
3. Forecast demand of single lever mixer for the year 1999-2003.
4. Study on product specification and production processes.

5. Select a suitable production process and raw material.
6. Determine the optimal capacity for setting up a factory.
7. Set up financial evaluations.
8. Conclusion and recommendations.

1.6 Literature reviews

A feasibility study of Hydrogen Peroxide Plant from Methane (Kriangsak Tantonkit, Industrial Engineering, Chulalongkorn University, 1985)

This thesis provides many aspects that has to be concerned in setting up the Hydrogen Peroxide Plant in Thailand. The study considers in view of marketing, production process, engineering, raw materials, human resource management and business administration, including manufacturing costs and return on investment.

A feasibility study of Vinyl Acetate Plant in Thailand (Chokdee Wongkaew, Industrial Engineering, Chulalongkorn University, 1985)

This study shows that there is an increasing in import volume and price of Vinyl Acetate. From the fact that the raw materials used in production can be produced in Thailand, thus the study illustrates the possibility in setting up a Vinyl Acetate Plant. This study also provides the appropriate location, optimal capacity, etc.

An Engineering Economic Analysis for setting up a new plant in small-tire industry
(Tawatchai Hanchanchai, Industrial Engineering, Chulalongkorn University, 1991)

The research analyze many factors that effect the prototype plant which can help in consideration in setting up a new plant. It studies the feasibility in economic and engineering aspects.

A feasibility study for small steel-rod factory (Chanthana Juntaro, Industrial Engineering, Chulalongkorn University, 1977)

The research studies on the feasibility for the investment a small steel-rod factory in Thailand. The scope of this study is consist of a feasibility in marketing and engineering, including production cost and return on the investment. Furthermore, it also considers the appropriate location of the factory.

A study of Establishing a Flexible Abrasive factory in Thailand (Sommai Tongpipatn, Industrial Engineering, Chulalongkorn University, 1979)

This research study on the feasibility of setting up a coated abrasive paper factory in Thailand. The ways to study in this research can be adopt to use in the other study.

Project feasibility study for businesses and industries. Chanthana Juntaro and Sirichan Thongprasert, 1993, Chulalongkorn University.

This book explains concept of project feasibility study in many aspects. It also includes the guidelines for feasibility study in many businesses. It starts with overview and then go to how can we know the market requirement in order to forecast the sale volume of the product. Next, it shows the issues that we should consider in engineering study, administration, financial study and economic study. The last session concerns the effect to environment. Furthermore, many

examples of calculation in financial analysis such as NPV, IRR, breakeven point, etc. can be adopted.

A comparative study of manufacturing of reinforced plastics container by various process (Krisda Yenbutr, 1985, Chulalongkorn University).

This study compares many of production processes that can be used to produce reinforced plastics container. The researcher use a packaging software name "Multiplan" to summarize the data. This study also help us in selection of a proper production process for different production volume.

General catalogue. (Rubinetterie Teorema S.p.A., Italy).

This document illustrates the production process of producing faucets. The process starts with the core, a resinate sand form, molded by automatic machines. Then, the core is placed in a shell, another machine, where the cast brass is poured at about 1,000 C. After some other processes, a work piece from foundry stage will become the body of the faucet. Next, the work piece is submitted to pre-testing hydraulic and air controls in order to check porosity and quality of product. Then, the work piece will be transferred to finishing. The chromium plating is totally automated. The work piece will be dipped into chromium-anhydride baths obtaining a thick and bright surface. After chromium-plating, the other parts such as handle, brass fixing, etc. which are produced by special turning lathe will be assembled with the body of faucet. All faucets will be tested and checked the quality before packing and then the faucets will be shipped to customers. This document gives us some information about the kinds of mechanism in faucets. Finally, it also gives the information about the international standards concerning the faucets. The international standards are as follows: I.C.I.T.E. (Italy), AFNOR NF 18-201/18-202 (France), .etc.

The factory. (FIR Rubinetterie S.p.A., Italy).

This document shows the production process of faucet. It also gives information about raw materials, machines, designs, and international standards.

Thai Industrial Standard for faucets 1278-2538. (The office of industrial standard, Thailand, 1995)

This document provides the definitions, types, dimensions and materials of faucets. It also describes about general characteristics, pressure test, finishing and thickness of finishing, leak test, packaging, label and trademark, method of sampling and finally the method to test the quality.

Costs of doing business in Thailand. (Office of the Board of Investment, Aug.1998).

This document provides typical costs of starting and operating a business e.g. labor costs and major regulations, tax rates, transportation costs, communication costs, utility costs, including the information about industrial estates and their facilities.

Forecasting. (Logistics and Operation management, Warwick manufacturing group).

The document mentions about forecasting methods and method of selection. Three basic categories of forecasting method are; qualitative, time series, and causal model. Qualitative method is normally used when there is no quality data or lacking on quantitative data. There are many qualitative techniques e.g. Delphi, scenario writing, cross-impact matrix, analogies, catastrophe, relevance tree, etc. Time series and Causal model are quantitative method base on historical data. Time series method uses past data to establish patterns and then set up a statistical model for forecasting. Time series are trend

curve fitting, classical decomposition, moving average, exponential smoothing, Holt-Winter's method, adaptive response and Box-Jenking. Causal model or Regression analysis uses past data to establish the relation among variables and then use the relation for forecasting.

Manufacturing process technology. (The University of Warwick, 1998).

This value document provides the overview of materials and manufacturing process technologies. The materials in this document are very useful in stage of selection the most appropriate raw material and production process.

Industrial Business in 1997 and Trend in future. (IFCT, Thailand, 1997)

This research shows the overall world economy and Thai economy in 1997 and the trend in 1998. It also gives the situation of financial market and its trend.

Growth rate of the world economy in 1997 was 4.1%, the same level as those in 1996 although there has been the financial crisis Asia. This is because such crisis happened in the second half of 1997 while the growth of US economy, as well as the European countries economy, in the first half of 1997 was substantially higher those in 1996.

However, though the financial crisis in Asia hardly affect the world economy in 1997, but the Asian countries, even Japan, have been affected tremendously. Hugh shrinking in trade among those countries has been caused by the devaluation, which started from Thailand, Indonesia and followed by South Korea, then spread over this region. The devaluation of the currency lead to the liquidity crisis, many financial institutions and companies went bankrupt, the unemployment rate jumped. Finally, Thailand, Indonesia and South Korea had to ask for the rescue package from IMF.

In Thailand, the devaluation of the baht has helped improve the trade balance via the shrinking in import. In the fourth quarter of 1997, both trade balance and current account were surplus because of the moderate inflation rate and the increase in VAT from 7% to 10%.

Regarding the trend of the year 1998, The first quarter of 1998, the economic situation was still depressed continuously. Production, investment and export have been contracting. However, the measure launched by the government to tackle the crisis helped diluting the problem. The baht was more stable, the inflation rate was lower than expected by IMF, furthermore, the liquidity crisis was relieved by debt restructuring, fund raising via global bond issued by the Ministry of finance, etc. If those measure work efficiently, it will improve the confidence of the investor, then help increase the liquidity, the interest will come down and also the cost of fund.

This research forecast that Thai economy in 1998 will contract by 5.7% due to the rigid financial and monetary policy which has been caused by the IMF's condition to stabilize the economy and solve the severe liquidity problem. However, in 1999, the economy will go sideways with the growth rate around 2-3%, but the real cost of production will come down.

Principles of Corporate Finance (Richard A. Brealey, Stewart C. Myers, 5th edition, McGraw-Hill, 1996)

This book contains the theory of finance. Financial Evaluation helps us make the right decision on which project is worth to invest, which project is not. This book provide the basic concepts about finance which can facilitate the financial evaluation for the project, such as:

1. Present value

It is the fact that we will invest in the project that is worth more than it cost, but how can we value the project. Since the time of consuming and generating cash of one project is different, we cannot simply compare its value to its cost.

As written in Chapter 2 of this book, the first basic principle of finance is that *a dollar today is worth more than a dollar tomorrow*, because the dollar can be invested to start earning interest immediately. The concept of Present Value must be applied in order to calculate the earnings from and the cost of the project at the same point of time to make the comparison be possible. The below formula shows how to calculate Present Value:

$$\text{Present Value (PV)} = \text{discount factor} \times C_1$$

Where

$$\text{Discount factor} = 1/(1+r)$$

C_1 = the expected payoff at time period (1)

r = rate of return, is the reward that investors demand for the accepting delayed payment

In conclusion, 'the present value of a delayed payoff may be found by multiplying the payoff by a discount factor which is less than 1' (due to the fact that a dollar today is worth more than a dollar tomorrow).

'To calculate present value, we discount expected future payoffs by the rate of return offered by comparable investment alternatives.' This rate of return is often referred to as the discount rate.

Followed is the example from this book, " the real estate investment, assuming for the moment that the \$400,000 payoff is a sure thing. The office building is not the only way to obtain \$400,000 a year from now. You could invest

in other securities maturing in a year. Suppose these securities yield 7% interest. How much would you have to invest in them in order to receive \$400,000 at the end of the year? That's easy: You would have to invest $\$400,000/1.07$, which is \$373,832. Therefore, at an interest rate of 7 percent, the present value of \$400,000 one year from now is \$373,832. “.

2. Net Present Value (NPV)

After getting Present Value of the future cash flow, we can find that the project is worth more than its cost or not by subtracting the required investment from the present value of the future cash flow, as illustrated in the below formula and example:

$$\text{NPV} = \text{PV} - \text{required investment}$$

IF we consider the previous example, “The building is worth \$373,832, but this does not mean that you are \$373,832 better off. You committed \$350,000, and therefore your net present value (NPV) is \$28,832 (or $373,832 - 350,000$)”.

‘In other words, your office development is worth more than it costs – it makes a net contribution to value.’

Therefore, we can conclude that only project with the *positive NPV* is worth to invest.

3. Payback Period

The concept of ‘Payback Period’ is described In Chapter 5. The payback period is the period that the initial outlay on any project is recovered, i.e. it shows how rapidly each project pays back its initial investment. ‘The payback period of

a project is found by counting the number of years it takes before cumulative forecasted cash flows equal the initial investment.'

However, using this concept to perform the project evaluation has some drawbacks which may cause misleading decision. Such drawback can be illustrated in the example from Chapter 5:

Project	C_0	C_1	C_2	C_3	Payback Period, years	NPV at 10%
A	-2,000	+2,000	0	0	1	-182
B	-2,000	+1,000	+1000	+5,000	2	+3,492

From the above table, the payback rule gives a different answer from the net present value rule. The net present value rule tells us to reject project A and accept project B by considering the sign of NPV. While the payback rule with a cutoff period of 1 year tells us to accept only project A.

The book explain the reason for the difference that 'payback gives equal weight to all cash flows before payback date and no weight at all to subsequent flows.'

This book also suggest that 'In order to use the payback rule, a firm has to decide on an appropriate cutoff date.'

4. Internal rate of return (IRR)

From Chapter 5, 'The internal rate of return is defined as the rate of discount which makes $NPV = 0$. This means that to find the IRR for an investment project lasting T years, we must solve for IRR in the following expression:

$$NPV = C_0 + C_1/(1+IRR) + C_2/(1+IRR)^2 + \dots + C_T/(1+IRR)^T = 0$$

The internal rate of return rule is to accept an investment project if the opportunity cost of capital is less than the internal rate of return.

For example, consider a project which produces the following flows:

C_0	C_1	C_2
-4,000	+2,000	+4,000

By solving for IRR from the equation:

$$NPV = -4,000 + 2,000/(1+IRR) + 4000/(1+IRR)^2 = 0$$

$$IRR = 28\%$$

From the equation, we can see that if the opportunity cost of capital is less than the 28% IRR, then the project has a *positive* NPV when discounted at the opportunity cost of capital. If it is equal to IRR, the project has a *zero* NPV. And if it is greater than the IRR, the project has a *negative* NPV.

5. Sensitivity Analysis

Since the future cash flow of the project come from forecasting, we have to face with high level of uncertainty, especially in market demand, sales, selling price, cost of raw material etc. We also have to consider the changes in those variables and look at the effect on the outcome of the project. This book suggests the 'sensitivity analysis' to show the result from worse-than-expected and better-than-expected situation. As written in Chapter 10, 'Sensitivity analysis allows you to consider the effect of changing one variable at a time. It boils down to expressing cash flows in terms of key project variables and then calculating the consequences of misestimating the variables.'

Security analysis handbook (Wallstreet Finance and Securities research team, 1993)

This handbook provides several methods to evaluate the securities, both fundamental and technical aspects. It also describes about the financial ratios such as ROE, ROA, D/E ratio, etc., which is used to analyze the attractiveness of the security. These ratios can be applied to analyze the investment project as well. Some useful ratios can be illustrated in the below formulas:

$$\text{ROE} = \text{Net profit} / \text{Equity}$$

$$\text{ROA} = \text{Net profit} / \text{Total asset}$$

This handbook also contain the table summarize the meaning of each ratio, as shown below:

	Good	Bad
Growth rate		
- of sales	> GDP	< GDP
- of net profit	> P/E	< P/E
Efficiency of profit generating		
ROE	High	Low
ROA	High	Low
Gross profit ratio	High	Low
Net profit ratio	High	Low
Financial leverage analysis		
Debt to Equity ratio	<1.0	>1.0
Liquidity analysis		
Liquidity ratio	>2.0	<1.0

Statistics for business and economics (David R. Anderson, Dennis J. Sweeney and Thomas A. Williams, 6th edition, West Publishing)

Chapter 14-16 of this book describes about the Regression, which is the statistical method used in studying the relationship between two or more variables. The regression equation does not only show how the variables are related, but also can be used to forecast the value of dependent variable, given the value of independent variables. Therefore, the regression analysis is the well-known forecasting method.

Chapter 14 explains the concept of 'Simple Linear Regression', which is the simplest type of regression analysis involving one independent variable and one dependent variable in which relationship between the variables is approximated by a straight line. While Chapter 15 and 16 contain the concept of 'Multiple Regression', which is the regression analysis that involving two or more independent variables.

Regarding the simple linear regression, the regression equation that describes how expected value of y is related to x is illustrated below:

$$E(y) = \beta_0 + \beta_1 x$$

where

y = dependent variables

x = independent variables

E(y) = the mean or expected value of y for a given value of x

β_0 = y intercept of the regression line

β_1 = slope of the regression line

In order to get the regression equation, we have to collect historical data of value of x and y . Then the least square method is used to calculate the estimates of β_0 and β_1 . Finally we will get the estimated simple linear regression equation and we can forecast value of y for a given value of x .

However, this book also describes about how to use Spreadsheets such as Microsoft Excel to perform the regression analysis. By using spreadsheet, we can obtain not only the coefficients of the equation (β_0 and β_1), but also various statistical value which can be used for further analysis, such as:

1. R Square

R Square or the *coefficient of determination* can be interpreted as the percentage of the variation in y can be explained by the estimated regression equation

For example, if r^2 is 90.27%, we can conclude that 90.27% of the variation in y can be explained by the linear relationship between x and y .

2. Multiple R

Multiple r or the *correlation coefficient* is a descriptive measure of the strength of linear association between two variables, x and y . Values of the correlation coefficient are always between -1 and $+1$. A value of $+1$ indicates that the two variables x and y are perfectly related in a positive linear sense, vice versa.

3. t Statistic

t Statistic can be used to perform t test. The purpose of the t test is to see that whether we can conclude that $\beta_1 \neq 0$, i.e., x and y are linearly related. On

the other word, there is a statistically significant relationship between the two variables. However, if we cannot conclude that $\beta_1 \neq 0$, we will have insufficient evidence to conclude that a significant relationship exists.

4. F statistic

F statistic is used to perform the F test, based on the F probability distribution. An F test can also be used to test for significance in regression. However, with more than one independent variable, only the F test can be used to test for an overall significant relationship.

Manual for plumber (Home and Garden, Amarin Printing and Publishing, 1998)

A part of this book describes about types of faucet, advantages and disadvantages of each mechanism, including problem solving for faucets.

Faucets can be classified into 5 types as follows.

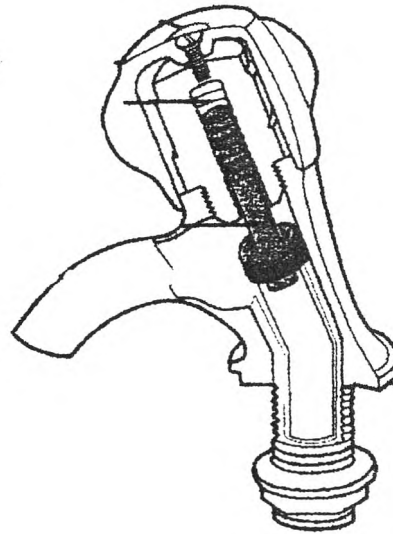
1. Compression cartridge
2. Port control faucets
3. Stainless steel ball valve
4. Cylinder valve & washerless system
5. Ceramic cartridge

1. Compression cartridge

Compression cartridge is the cheapest faucet and widely used more than 60 years. Inside mechanism is shown below.

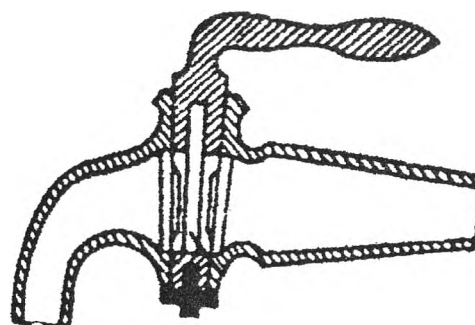
User can control volume of water by turning the handle 0-360 degree. Advantages are low price and high availability, but disadvantages are short working life due to deterioration of rubber ring, and inconvenience in use because user must turn the handle many times for a single use. Furthermore, this

kind of faucet consumes water more than the other kinds of faucet, because it takes more times to turn-on or turn-off the valve.



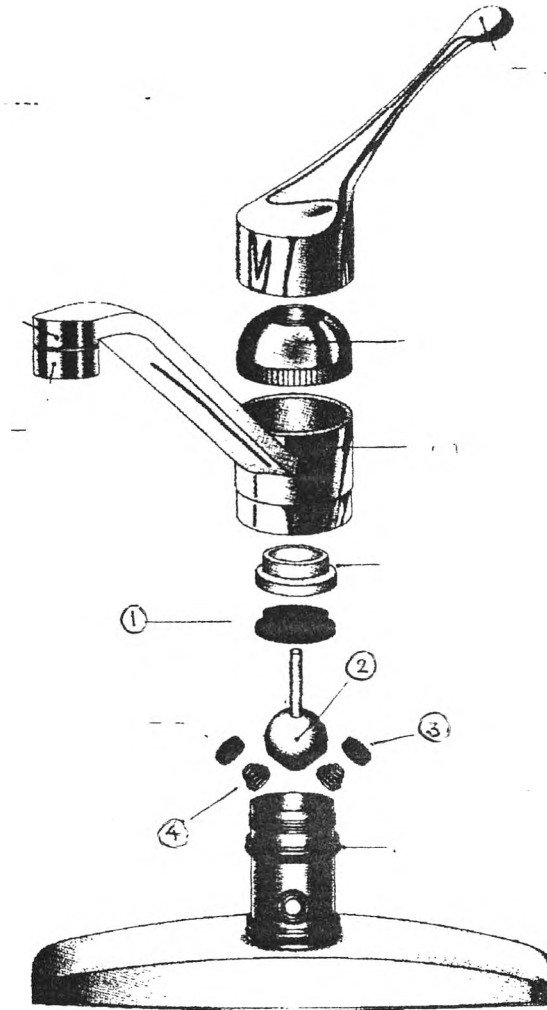
2. Port control faucet

Port control faucet is the faucet that normally used as stop-valve or angle-valve in system. Turning the lever 0-90 degree can control water flow. The inside mechanism consists of metal ball with hole for supplying and controlling the volume of water.



3. Stainless steel ball valve

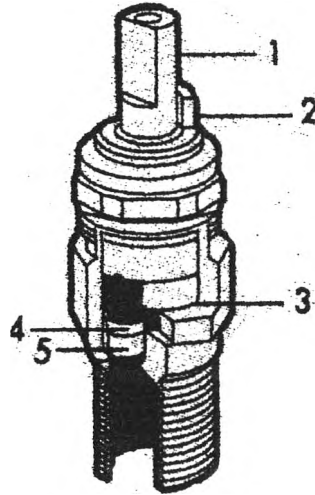
This kind of faucet is widely used worldwide, especially in USA. User can control volume of water by turning the lever 0-180 degree. Inside mechanism consists of a ball with hole, springs, rubber ring, and seals.



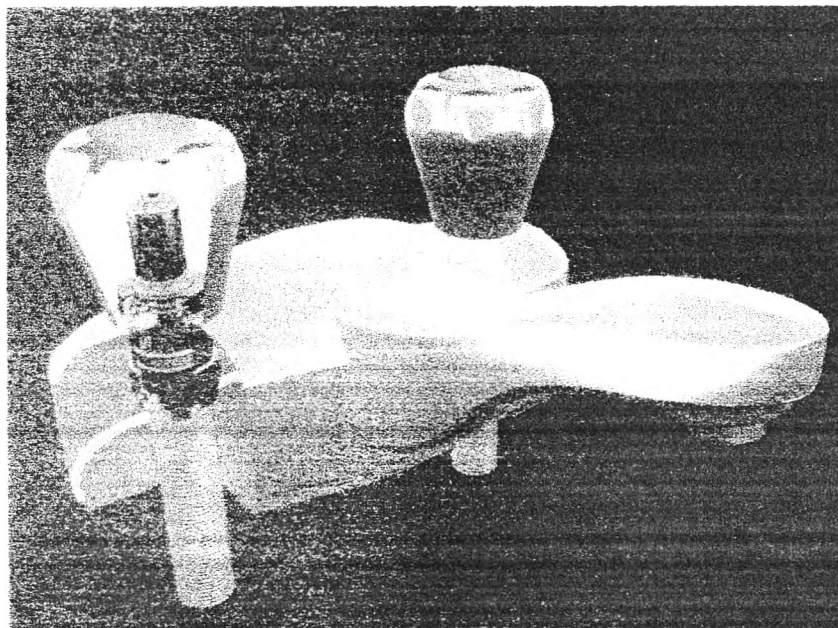
1. seal
2. controlling ball
3. rubber ring
4. support spring

4. Cylinder valve & washerless system

This kind of faucet is widely used in USA for more than 60 years. Price is medium to high. Inside mechanism consists of plastic cylinder with stainless sheet at the end for controlling water flow as shown below.

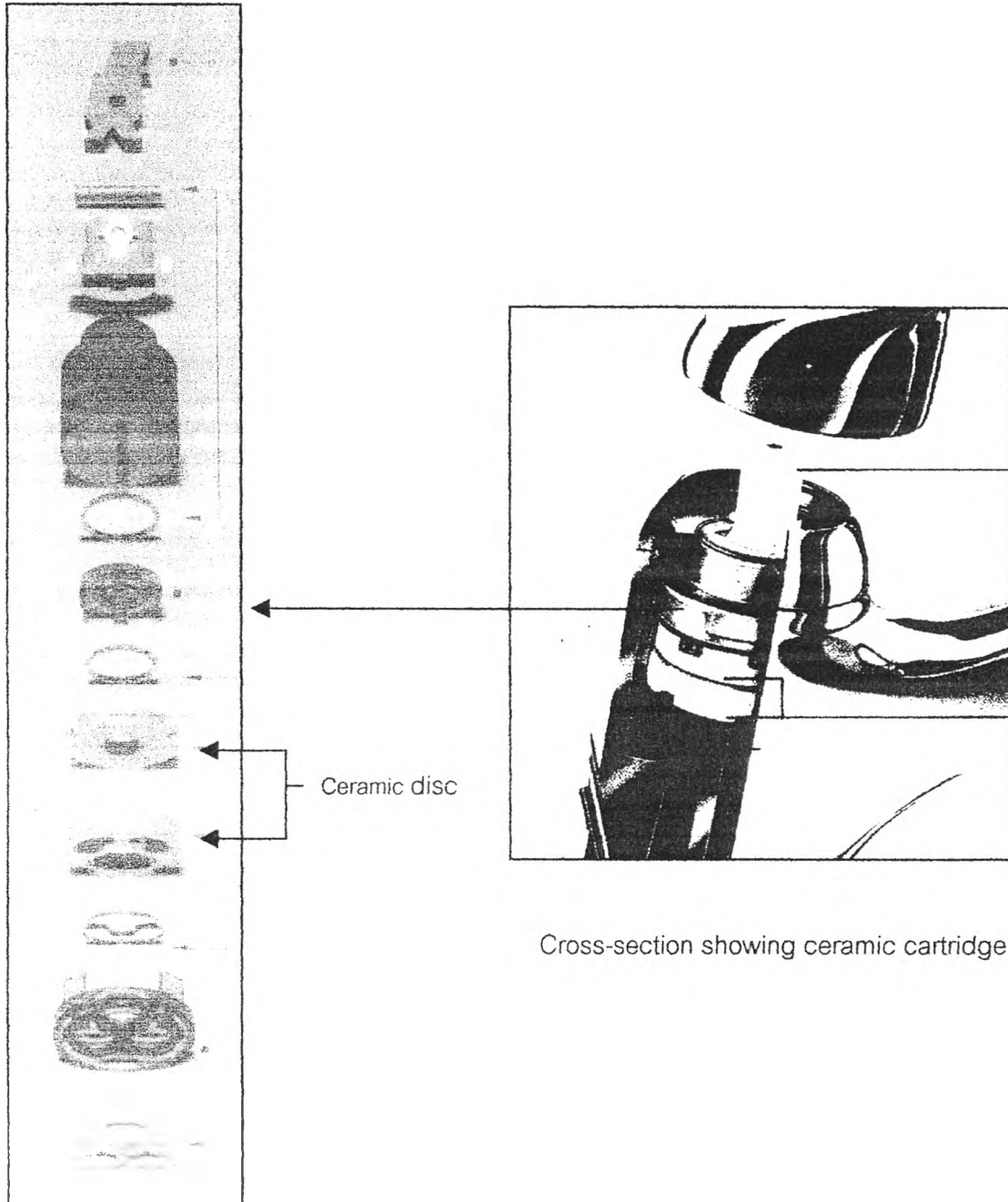


1. plastic cylinder
2. locking thread for 180 degree turn
3. stainless part for durability
4. seal with self lubricant
5. stainless spring



5. Ceramic cartridge

This type of faucet is widely used in Europe and Asia more than 35 years. Mechanism consists of ceramic disc, seal, and cylinder. Two smooth ceramic discs are the major parts which are used for controlling the flow of water. Sample of components in a ceramic cartridge is in below figure.



Cross-section showing ceramic cartridge