Dishwashers feature microprocessor controlled using electronic control unit marke...

Introduction

The first reports of a mechanical dishwashing device are of an 1850 patent by Joel Houghton of a hand-powered device. This device was made of wood and was cranked by hand while water sprayed onto the dishes. This device was both slow and unreliable. Another patent was granted to L. A. Alexander in 1865 that was similar to the first but featured a hand-cranked rack system. Neither device was practical or widely accepted.[1]

Modern dishwashers are descended from the 1886 invention of Josephine Cochrane, also hand-powered, which she unveiled at the 1893 Chicago World's Fair. Cochrane was quite wealthy and was the granddaughter of John Fitch, the inventor of the steamboat. She never washed dishes herself and only invented the dishwasher because her servants were chipping her fine china.

Models installed with permanent plumbing arrived in the 1920s. In 1924, William Howard Livens invented a small dishwasher suitable for domestic use. It had many of the features of a modern dishwasher, including a front door for loading, a wire rack to hold crockery and a rotating sprayer.[2] Livens' invention was not, however, a commercial success. Electric drying elements were added in 1940.

Adoption was greatest at first in commercial environments, but by the 1970s dishwashers had become commonplace in domestic residences in the US.

The international standard for the capacity of a dishwasher is expressed as standard place settings. Dishes or plates of irregular sizes may not fit

properly in a dishwasher’s cleaning compartment, so it is advisable to check for compatibility before buying a dishwasher.

Dishwashers that are installed into standard kitchen cabinets have a standard width and depth of 60 cm (Europe) or 24 inches (US), and most dishwashers must be installed into a hole a minimum of 86 cm (Europe) or 34 inches (US) tall. Portable dishwashers exist in 45 and 60 cm (Europe) 18 and 24 inch (US) widths, with casters and attached countertops. Dishwashers may come in standard or tall tub designs; standard tub dishwashers have a service kickplate beneath the dishwasher door that allows for simpler maintenance and installation, but tall tub dishwashers have approximately 20% more capacity and better sound dampening from having a continuous front door.

Features

Present-day machines feature a drop-down front panel door, allowing access to the interior, which usually contains 2 pull-out racks (sometimes 3); racks can also be referred to as “ baskets”. In older U. S. models from the 1950s, the entire tub rolled out when the machine latch was opened, and loading/removing washable items was from the top, with the user reaching deep into the compartment for some items. Today, “ dish drawer” models mimic this style, while the half-depth design eliminates the inconvenience of the long reach that was necessary with older full-depth models.

The inside of a dishwasher, called the tub, can be composed of plastic or stainless steel. Stainless steel tubs resist hard water, provide better sound dampening, and preserve heat to dry dishes faster. They also come at a

premium price. Older models used a baked enamel on steel and are prone to chipping and erosion; chips in the baked enamel finish must be cleaned of all dirt and corrosion then patched with a special compound or even a good quality two-part epoxy. All European made dishwasher feature as standard a stainless steel interior.

Many newer dishwashers feature microprocessor-controlled using Electronic Control Unit (ECU), sensor-assisted wash cycles that adjust the wash duration to the quantity of dirty dishes (sensed by changes in water temperature) or the amount of dirt in the rinse water (sensed chemically/optically). This can save water and energy if the user runs a partial load. In such dishwashers the electromechanical rotary switch often used to control the washing cycle is replaced by a microprocessor but most sensors and valves are still required to be present. However, pressure switches (some dishwashers use a pressure switch and flow meter) are not required in most microprocessor controlled dishwashers as they use the motor and sometimes a rotational position sensor to sense the resistance of water, when it senses there is no cavitation it knows it has the optimal amount of water.

Most dishwashers include a large cone or similar structure in the bottom dish rack to prevent placement of dishes in the center of the rack. The dishwasher directs water from the bottom of the dishwasher up through this structure to the upper wash arm to spray water on the top dish rack. Some dishwashers, including many models from Whirlpool and Kitchenaid, use a tube attached to the top rack that connects to a water source at the back of the dishwasher which allows full use of the bottom rack. Late-model

Frigidaire dishwashers shoot a jet of water from the top of the washer down into the upper wash arm, again allowing full use of the bottom rack (but requiring that a small funnel on the top rack be kept clear).

Sound damping

Modern dishwashers are quieter than older models. Using blankets, panels, and sound-absorbing materials in various configurations, dishwashers can achieve sound damping levels down to 39 decibels or so. Undampened, low-end dishwashers generally output noise levels of anywhere from 65-70 decibels. Most manufacturers generally use their

Drying

The heat inside the dishwasher dries the contents after the final hot rinse. Plastic and non-stick items may not dry properly[13] compared to china and glass, which hold the heat better. Some dishwashers incorporate a fan to improve drying. Older dishwashers with a visible heating element (at the bottom of the wash cabinet, below the bottom basket) may use the heating element to improve drying, however this uses more energy.

1. Customer satisfaction

1. 1 Stakeholder

1. 1. 1 Customers

The customers might be an individual person, hotel, restaurant, coffee shop, or any food outlet shop or any household. It is of course used for washing everyday use dishes. They expect all the truth from manufacturers about the issues and what this machine can and cannot do. They neded to know every

thing about the product and get what they have paid for whithout been cheated or misled by falsefull advertisements. They also expect reasonable and fair prices.

1. 1. 2 The shareholders

The company that makes these dishwashers like fisher & pickle, Westinghouse, Kelvenator, LG, Bosch…etc have the obligation to pay the shareholders as they expect a profit out of these businesses

1. 1. 3. Employees

These includes all the managing staff, design engineers and workers. They expect to be paid their wages and salaries on time, good and safe working conditions.

1. 1. 4 Wholesalers/Retailers

Big wholesalers buy in bulk and sell for small retails shops. Big shops like Harvey Norman and Big W for example they are retailers and they buy direct from manufacturers. All these people expects easy transactions with the manufacturer, fair profit margin, quick supply time, quick warrantee claims processing and refund policey.

1. 1. 5 Couriers

They offer these goods transfer from manufacturer to the warehouse of wholesalers/ retailers.

Thy expect to get paid on time, short witing time for loading and unloading their trucks, easy access to docking stations.

1. 1. 6 Dishwasher detergent producers

These machines where designed to use a special detergent which is different than that used for hand washing or for clothes washing machines. Also these machines use a special liquid to netutralize water and give clear looking glassware finish. So there are producers for these products. They expect to sell their products that dishwashers design is well made to achieve the best results, sparkle clean dishes after each use.

1. 1. 7 Water supply authority

Water usage and supply to run these machines, as they are water consuming machines and must satisfy some criteria as water is scare resources in Australia. They expect dishwashers that save water .

1. 1. 8 Electricity supply co.

The supplier of electricity to run these machines one of those who be a stackholder. They expect dishwashers to consume little energy and have high star energy rating. Also encouraging moving to “ Green ” or “ environmentally friendly machines.

1. 1. 9 Australian standards board

This is the official board who issue the required specifications that each product must comply with and perform as stated in these standards, known as ASO. They expect the standards to be adhered to.

1. 1. 10 Australian Tax Office

They are the authority who inspects the manufacturers and retailers and how they comply with the applicable laws of taxation in Australia and its territories.

1. 1. 10Fair Trading/ ASICS/Workcover

Being the government bodies who issues the required licences to operate as manufacturer or retailer. They expect from manufacturers to renew their licensec all times and comply with all the requirements including the insurance and safety at work. To make theire premises available to inspection when requested.

1. 1. 10 Competitors

The competitors of the same product expect fair game. No cheating or misleading information been given to any third party and that no defamation been made to any competitor.

1. 1. 10 community

The community expects contribution with charity and community activities. More jobs for the locals.

1. 2 Ways to capture customer needs

1. 2. 1 Internet survey and emails

By using the internet , manufacturers can have access to customers and end users by sending emails and online questions, feedback to identify customer needs and expectations from a product. In this case who they expect the dishwasher to work and perform.....

Desinging the questinening is as follows:

1. What is your gender?

Male

Female

2. What is your age group?

<19

19-24

25-29

30-34

35-39

40-44

45-49

50+

4. What brand of your dishwasher you are using now?

5. What is the price range of your current dishwasher?

300-500

500 – 700

700-900

1000-1300

1300-1600

> 1600

6. What is the price range would you pay for a new dishwasher?

300-500

500 – 700

700-900

1000-1300

1300-1600

> 1600

7. How important these requirements for you?

Please rate these requirements from 1-5, 1 is lowest and 5 is the highest important?

Easy to use..... 4

Can fit in it all dish sizes..... 5

Modern style..... 4

Quiet operation..... 5

Safe for use.....5

Easy to fill..... 3

Rust resistance..... 5

Budget price..... 4

No of years of warranty.....5

Colour (white)..... 3

Integrated water heater..... 5

Digital Display screen..... 2

If you have more comments or requirements about the product, please write them in the space

provided.....

.....

.....

.....

.....

Thanks for your time.

Please send your details below for your chance to win FREE Detergent for one year!

Name……

Address……

Contact Number and/or email……

Best time to contact……

How did you find about us ? ……

Thank you for your participation.

Other ways of getting customers' requirements are:

1. 2. 2Telephone questioning

By using telemarketing agency, manufacturers can end up with valuable information and details about the customer needs and requirements. So they know how to address these issues to satisfy those needs.

1. 2. 3 Brainstorming/focus group/discussion boards

By talking to other people, discussion boards or friends , Manufacturers know what customers need.

1. 2. 5 Warranty claims record

By sending letters by mail to random customers and get them to fill a survey questioner that can ask in details what customers are looking for and what they expect from a dishwasher.

1. 2. 6 Customers feedback

By reading or listening to the customers' feedback after using these machines. By going through warrantee claims and study what are the most occurring problems and how customers responded to them or suggested as alternatives to the malfunctioning part or process.

1. 2. 7 Benchmarking

By comparing the products to benchmarks, manufacturers can understand how close they are to the best product.

1. 2. 7 Market research

By doing a market research manufacturers will engage some specialized people to do a study and analysis for the market and how to meet these requirements by fulfilling all the expections in a product that can make all what the consumers need. Also will study competitiors and their products.

1. 3 Customer Requirements [Kano analysis]

These requirements are required by customers (home users) in their language, Not in technical terms but in simple expressions

1. 3. 1What is customers' needs or " MUSTS"?

Reliable

Easy to operate/user friendly

Quiet

Safe

No water leakage

Water saver

Electricity saver

Warranty is given

Different washing programs

Competitive price

1. 3. 2 What are customers' " WANTS"?

Long time warranty

Digital touch screen

Self-cleaning function

Stainless steel inside and outside

On-site or Pick-up warranty

Water temp control

Environmentally friendly

Remote control

Programmable, time-delay function

Economy cycle and heater bypass function

1. 3. 3 What are customers' " EXTRAS" Or " DESIRABLES"?

Extra discharge hose

Extra water supply hose

DVD and instruction booklet

One month free detergent

Free set of dishes with the co. logo printed

Part 2 QFM and FMEA

2. 1 Quality Function Deployment (QFD)

To translate the customer requirements into design requirements, we use the QFD chart as illustrated below:

2. 2 Failure Mode and Effect Analysis (FMEA)

Part 3 Supplier Selection and Evaluation

3. 1 Major Parts of a Dishwasher

Frame & body structure

Electric Motor

Discharge water pump

Spray arms

ECU-Electronic Control Unit

Front Panel Touch-Pads or Knobs

Wire-Steel baskets

Heating element

Water volume sensor

Water temp sensor

Intake valve and screen

Hoses

Detergent dispenser

Water cut-off solenoid valve

3. 2 Supplier Selection Criteria

The selected part is ECU.

The selection criteria is shown in the table below.

China

Japan

Thailand

Korea

Taiwan

Australia

Price

10

3

7

8

8

4

Quality of components

5

10

6

7

6

6

Warranty period

10

6

7

9

5

4

Delivery time

3

8

4

7

6

10

Return policy

6

7

8

10

9

4

Production capasity

10

7

8

9

9

6

Company image (reputation)

6

10

7

9

8

6

support

3

8

7

10

9

6

Reliability

5

10

6

9

7

8

Total

58

69

60

78

67

54

According to the company selection criteria, the main factors are:

Warranty

Return policy

Support

Reputation

The highest score was Korea, and all the above factors were satisfied by this selection.

For that reason we have picked Korea as our ECU supplier for the use in dishwashers.

Although, the quality comes second after Japan, but the good warranty period is very good and it should be in the favour of this company to be on our top list.

Australian companies suffer from many issues and only good in delivery time, price and quality is questionable and better be avoided along with china is also not on our short list.

4. Part 4 (Statistical Process Control)

4. 1 Key production process

External steel body production process

Interior lining stainless steel production

Painting exterior body

Front door production

Assemble frame together

Electrical wiring

ECU assembly

Assembly of interior lining

Assembly of spray arm

Front panel (touch-pad or knobs) assembly

Electric motor assembly

Heating element assembly

Small hoses connections

Wire steel baskets assembly

Detergent dispenser assembly

Testing

Packaging

4. Control charts

Different charts are used in representing data collected from samples taken from the production line.

When collecting sample (size is determined by which standards we are using), we may test or measure some thing and then collect these data to do some calculations and draw the chart as required.

The following 4 charts are used to measure things, whether the sample contains good or bad products, it doesn't matter, because all the sample will be tested or measured.

Measuring Charts:

4. 2. 1 X-Chart

X chart is used when measuring one item only every day or shift(sample size, n= 1). It is a destructive test. It is considered to be accurate because of the number of data collected over a period of time, week or month. By calculating the mean (x bar) and standard deviation (SD or Sigma) from the data collected during the month for example , using formulae given below , we can calculate the upper control limit (UCL) and lower control limit (LCL). Then chart is drawn. We have to wait for the end of the period to calculate the x-bar or standard deviation, that is why it is not sensitive for variation.

In our example of dishwasher, we will be using x-chart to control the process of manufacturing the water volume sensor .

By sampling and testing every day one sensor, for the first 15 days of this month(as required for this assignment), we have collected the following data from testing (measuring) the volume of water (in litres) that activated the sensor to open the electrical circuit of the" water cut-off solenoid valve" and hence stoped the water flow. This will maintain a constant water level inside the dishwasher preventing overflow and minimizing water usage.

Testing one item a day, measured the water volume recorded when the sensor responded.

The following numbers were collected and calculated, x bar, SD, and then finding UCL , LCL . X chart then drawn.

Time

X

k

x bar

SD (s)

UCL

LCL

Mon

10. 00

1

10. 00

0. 14

10. 43

9. 57

Tue

10. 10

1

10. 00

0. 14

10. 43

9. 57

Wed

10

1

10. 00

0. 14

10. 43

9. 57

Thu

9. 8

1

10. 00

0. 14

10. 43

9. 57

Fri

10. 1

1

10. 00

0. 14

10. 43

9. 57

Mon

10

1

10. 00

0. 14

10. 43

9. 57

Tue

9. 8

1

10. 00

0. 14

10. 43

9. 57

Wed

10. 20

1

10. 00

0. 14

10. 43

9. 57

Thu

9. 80

1

10. 00

0. 14

10. 43

9. 57

Fri

9. 90

1

10. 00

0. 14

10. 43

9. 57

Mon

10. 00

1

10. 00

0. 14

10. 43

9. 57

Tue

10. 10

1

10. 00

0. 14

10. 43

9. 57

Wed

9. 90

1

10. 00

0. 14

10. 43

9. 57

Thu

10. 20

1

10. 00

0. 14

10. 43

9. 57

Fri

10. 10

1

10. 00

0. 14

10. 43

9. 57

X bar= 10. 00

SD standard deviation= 0. 14

UCL= 10. 43

LCL= 9. 57

C4= Correction factor for k= 5(= 0. 94)

4. 2. 2 IMR-Chart

This chart is used when sample size , n= 1 , only one item is collected every day or shift and compared to the day before, it uses moving range to compare, i. e calculating the range between two samples to calculate the UCL and LCL. Instead of waiting the whole month, if I want to capture the variation now, this chart is useful. So it is sensitive in capturing any variation and can be detected and corrected, but it is not accurate as the x chart because it has only two data.

When the sample size to is more than one then other charts are used and I can do my calculations straight away.

4. 2. 3 X-bar and R-chart

This chart is used when sample size, is between2 and 9, n= 2-9. The following formulae is used.

4. 2. 4X-bar and s-Chart

If sample size is greater than 9, n> 9, then this chart is used.

If we are dealing with defected items taken from a sample , then different charts are used and here we will be counting numbers, not measuring or testing items. counting number of frequency, ie the number of defected items in the sample, or the number of defects in the whole sample taken.

These are explained by different charts as follows:

In case of counting defective items one of the following charts is used

4. 2. 5 p-Chart

When the sample size, " n" is varying or production output is different every day, or we are interested in finding the percentage of defeced items (proportional to the whole sample n), then we use this chart to count the defective items per sample taken. items that have any kind of defect will be counted as defected item. then data is collected, calculations are made using the following formulae and chart is drawn.

4. 2. 6np-Chart

Constant sample taken every day or shift, n= fixed , defective items are counted . then data is collected for a period of time , calculations are made using the following formule and chart is constructed. sample size must be the same every time.

When we are counting number of defects in a sample, one of the following charts is used

4. 2. 7 u-Chart

In the case of using variable sample size, n= variable, or the daily output is different or we are interested in knowing the percentage of defects (proportional to the whole sample), then we use this chart . Number of defects are counted in the total sample and data recorded. Then from data collected over a period of time , using the following formulae, all values are calculated and chart drawn.

4. 2. 8 c-Chart

When we count the number of defects on a fixed sample size, n= fixed, ie same sample size every time(every day), then this chart is used , defects are counted, data recorded, then used in the following formulae and chart is drawn. The sample size must be fixed evry day.

5. Continuous Quality Improvement

5. 1 at least 7 problem solving tools

Check sheet

Cause and effect diagram (fish bone)

histogram

Brainstorming

Data collection sheet

Pareto dia

Process flow chart

Problem solving form

Gantt chart

5. 2 at least 5 problems that may occur during the use of our product

Washing is not clean

Water is wasted

Blocked screen

Not taking water

Water traped inside

Not drying

Food residual

Noise

Burning smell

Water leaking

Foggy glass finish

Discolouring of pots

5. 3 select one prob and apply min 4 prob solving tools an techniques to rectify that prob

Application of prob solving

5. 3. 1 check sheet

Excel

5. 3. 2 Not clean finish: solving

Brainstorming

Discussing found that

Put dishes in proper direction

Small dishes inside the big

Remove food remaining before loading

Use the right detergent

Use rinse aid

5. 3. 3

Gantt chart