

Quality and its Attainment

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Development of Quality Specifications

Primitive industrial societies required no *specifications*. Commerce was by *barter*. The transaction involved goods then and there physically present, subject to inspection and evaluation by both parties. In such circumstances specifications were not required.

The traditional absence of specification goes far to explain the great extent to which people once leaned on the good craftsman. The craftsman both designed and made the product. He knew not only the design; he knew very well the extent to which the product conformed to the design. Knowing all this gave him a great advantage over the consumer. A man who could design a good product and then make the goods conform to the design was much sought after.

With the growth of commerce, many, even most, transactions took place away from the market place. *Producer* and *consumer* did not meet face to face but only through intermediaries. The goods were not present physically, the goods may not even have been in existence. Hence understanding the nature of goods had to come from other means. i.e. samples, descriptions, *specifications*.

The spread of commerce gave rise to specification by sample. The sample divided between seller and buyer, became a durable statement of specification. The use of specification 'per sample' remains prevalent even today in some industries such as textiles and clothing.

Specification by sample presents many limitations. The expense, bulk, weight, etc., of samples can be substantial if not prohibitive in many situations. With the development of writing, specification by written description was evolved and has been used extensively ever since.

The written quality specification is as old as recorded history. The Bible gives specifications for buildings, food, and other products. Records before Christ include Babylonian (under Nebuchadnezzar, 605-562 BC); Chinese pottery-making in the factories at King-To-Ching (1644 BC.) and Egyptian manufacture of linen (2000 BC).

In the absence of measurement, quality characteristics were described in words. There was great uncertainty in the interpretations of words, and the law courts avoided getting into the controversies by putting the risk on the buyers. The rule was *caveat emptor* (let the buyer beware). The rule of *caveat emptor* was entirely logical in market place barter. It was considered that the opportunity to examine the goods prior to barter was an adequate basis for a meeting of the minds of

the parties. Once their minds had met and the bargain was struck, the courts avoided the question of whether the one or the other had made a bad bargain.

To a large extent, the principle of *caveat emptor* still prevails when the purchase is for a specific article—this can of tomatoes, this suit of clothes. Reputable companies are, however, less strict than the legal rule permits, and there is also some implied warranty. The can of 'tomatoes' must contain tomatoes and not beans. However, if the tomatoes have a flat taste, or no taste at all, there is no legal recourse. Similarly, if the suit shrinks drastically in the first rain, the buyer has no legal recourse unless there was some representation that the suit would not shrink. This shrinkage warranty if present, would be an element of the specification and would then be binding on the seller.

Historically, the great majority of goods have been sold 'as is'. The movement to define and to label goods as to their ingredients, their formulae, their impurities, the process by which they were made, etc., is of very recent origin.

With the rise of the science of measurement, there arose the great possibility of specification by numbers. Industry as we know it today could hardly function otherwise. Even this development took place in a series of stages.

Measures of length were probably the first to develop. Standards of length evolved for the city, state, empire, the prime standard bearing the king's name and being deposited in the leading temples. The Egyptian royal cubit is known to have been standardised at about 20.63 inches ± 0.2 inches prior to 1550 BC. However, different states had cubits of different length (the cubit was meant to measure the length of a man's forearm from the elbow to the tip of the middle finger). There was no international standardisation.

Measures of weight and volume likewise evolved, the early standards varying about ± 5 per cent for weights and about ± 10 per cent for volume, even within the same state. Improvements in accuracy were slow until the nineteenth century. As late as the sixteenth century the legal definition of the foot in Germany was the average of the length of the left feet of 16 men as they emerged from church on Sunday.

In the simple societies the specification served mainly to facilitate a meeting of the minds between buyer and seller. In the complex industrial society of today, the specification has meaning far beyond this. The quality specification more nearly takes on the characteristics of an industrial law.

The modern factory is an industrial community complete with laws to specify what is right and wrong, and with law enforcement officers to observe the acts of the citizens and to judge whether these acts conform to the laws. One of these systems of industrial legislation is that which includes laws in the form of quality specifications, and law enforcement officers in the form of inspectors. This parallel is remarkably useful in understanding the fundamentals underlying the inspection job. This can well commence by analysing the nature of the quality specification, for it is the quality law of the industrial community.

As factories grew and departmentalized, and as products became increasingly complex, specification by sample became increasingly cumbersome. Too many people needed to refer to the samples. If, to meet this need, several samples were made up, they were not uniform anyway. Assemblies were always fitted together specially, as there was no interchangeability of parts.

The development of the idea of interchangeability was a milestone in industrial progress. A limiting factor in manufacture had been the great difficulty of assembly by filing and fitting, requiring much time by a highly skilled workman. But achievement of interchangeability required standardisation of units of measure. If shafts were ordered from shop A, and bearings from shop B, then, even though the first was well designed, the parts would not mate properly, because the length of the 'inch' in shop A was not the same as the length of the 'inch' in shop B. The rise of national standardisation and of international standardisation was a vital factor in achieving the precision industries of today.

When written specifications and drawings began to evolve, the practice was to give 'flat dimensions,' i.e., one number to define the characteristic. But as shopmen began to measure what they were making, they found that, try as they might, the product differed somewhat from the specification. When this was revealed to the designers, their first reaction was of the sort, 'It says three inches. So make it just three inches not more or less.' However, experience proved otherwise, and the concept of tolerance was developed.

Purpose of Quality Specifications

The purpose of specification is definition. The thing defined may be a tract of land, a job, a product. The subject of quality specifications may include: (1) Materials, (2) Processes, (3) Products, (4) Method of test, (5) Criteria for acceptance and rejection and (6) Method of use. Some or all of these may be incorporated in the same document, which is then generally referred to as a 'specification.'

'Materials' refers usually to components, ingredients, or parts entering semi-finished goods, while 'product' usually refers to finished goods.

Once a definition is available, any of the parties in the scheme of industry can communicate with any other and use the shorthand of the specification to define a complex product. A buyer can order a No. 32 blower, or a ton of steel perspecification No. 15 and in each case the seller will know what the buyer is talking about. The production departments of the selling company will know what to make, the receiving inspector of the buying company will know what to test for and so on. The commercial usefulness of the specification needs no elaboration.

Types of specifications

Products and materials specifications—These are specifications which apply to products or materials. They usually include the following clauses:

- (a) **Originator:** This is the author of the specification. This is normally a department of a company, an institution of the government of a country, or a professional society.
- (b) **Specification identification:** This includes the usual name of the product or the material to which the specification applies; a number which serves as a shorthand description; a date and issue number and preferably, in addition, the date and issue number which the current issue has superseded.
- (c) **Scope of the specification:** This sets out the product or class of products to which the specification applies. The scope also includes the limitations where the specification is not to apply generally.
- (d) **Detailed requirements:** This is a listing of the desired quality characteristic and the standards or tolerances applicable to each. These quality characteristics and tolerances are the heart of the specification.
- (e) **Method of test:** The methods by which tests should be carried out to determine quality characteristics given in (d) above are given here. Because of the wide standardisation of test methods expression of these is often by reference to standard test designations published separately. Methods of test generally include the method of preparing the specimen for test.

- (f) Sampling criteria: The method of test is the means for deciding the degree of conformity, to the tolerances, of a *single unit* or specimen of the product. However, a further need is to judge the degree of conformity of the *lot*. This gives rise to sampling criteria.
- (g) Packaging, Identification, Handling and Storage: This includes information as to the types of containers, quality of product per container, labelling or other identification, extent of protective packaging, type of transport, transport conditions, method of storage and safety precautions (Operation sheet, job sheet)....

Process specifications—The process specification serves two basic purposes:

- (1) Instruction to all hands on how to make the product successfully and economically. With the wide industrial trend to separate planning from execution, the process specification records the agreed on plan.
- (2) An indirect means for specifying product quality. A pre-requisite for this is a proved cause and effect relationship between process conditions and subsequent product characteristics. Once such a relationship has been established, evidence of conformance to the process specification is also evidence of conformance to the product specification.

To achieve these purposes, process specifications generally contain,

1. Originator,
2. Specification identification,
3. Materials used, identified by their shorthand designation, and the quantities of each,
4. Sequence of operations to be performed,
5. Description of each operation, including machines and tools to be used, ingredient formulas, sequence of events, process conditions to be maintained, (Time, cycle, temperature, pressure, etc.)
6. Process testing to be performed. This emphasizes process acceptance rather than product acceptance.

What is 'Quality'?

The concept of 'Quality' is very difficult to define precisely. No one single definition has yet been established. However a number of definitions exist which describes this very useful concept in many ways.

The International Organisation for Standardisation gives the following meaning to 'Quality':

'Quality' is the term covering any and every *characteristic property and/or performance* of a product or service that can be evaluated to determine whether the product or service meets the *demands* of those to be served. In more simple words the concept 'Quality' is often associated with 'consumer quality' that is, 'the total of all characteristics of a product as looked upon by the consumer.'

Also the notion of 'quality of goods' comprises their properties both at the time of their *purchase* and in the process of using them (eg. durability, reliability, etc.)

In the field of statistical quality control, the quality of a product is often referred to as the *degree* to which it meets the requirement of the customer. The European Organisation for Quality Control (EOQC) adopted the definition of quality as the following:

"The quality of a product is the degree to which meets requirements of the customer. With manufactured products quality is a combination of quality of *design* and quality of *manufacture*."

It is to be noted that this definition makes a distinction between 'quality of design' and 'quality of manufacture.'

A difference in specification for the same functional use of a product is a difference in quality of design, often called the grade. The Rolls-Royce and the Ford automobiles serves the same basic function. However they differ in many features of design.

Quality of manufacture on the other hand, relates to the degree with which the product conforms to the design. A Ford which can run and a Ford which cannot run have the same quality of design, but they differ in quality of manufacture.

What is 'Quality Control'?

We have discussed in the earlier section the meaning attached to 'Quality'. The means and tools of achieving the 'Quality of products or services' may be designated 'Quality Control' within an organisation. This may be put in the form:

"The functions or collections of duties which must be performed in order to carry out the organisation's quality objectives."

In some organisations, the functions referred to by the term "Quality Control" are very broad, extending to the complete list of functions associated with quality. In other organisations, the term "Quality Control" is used to refer to a limited function such as inspection of the product or analysis of data.

How to achieve 'Quality Control'

Statistical Tools used—data. The achievement of good "Quality Control" practices is intrinsically connected with the practices adopted for collection of data. The entire scheme of control used in an organisation can fail if the 'data' used are not factual or not properly collected, since in statistical quality control, the decision as to whether the method of doing a particular job is appropriate is based on inferences made on analysis of data. The manufacturing procedure will be correct only if the data are analysed properly and the right judgements made. There is no chance of this happening unless the original data gathered is both accurate and appropriate.

In collection and analysis of data there are two basic points to keep in mind.

1. Will the data taken reveal the facts?
2. Are the data assembled, ordered and compared so as to reveal the facts?

No. 1 is a problem of sampling, and No. 2 is a problem of statistical treatment.

The method of sampling must be appropriate for the type of data required. When impurities present is the problem in a certain product, to take only one sample per day is hardly sufficient. Also in comparing defects produced by two workers, it is essential to take numerous samples. In other words, one must give full consideration to the reason for collecting data, proper sampling methods, and stratification. Simply because certain data can be collected easily, one should not take a disproportionate amount. Also partial data, which happens to be convenient to collect is not necessarily effective data.

And even using the correct sampling method in itself is not sufficient. It is necessary to see that the data represents the facts and that the statistical method employed is such that an objective judgement can be made.

Kinds of data—Even though one understands the necessity for having correct data, one may say 'I can't discover any data on my job' or 'I can't collect data.' Certainly on our jobs it is often difficult to obtain data in neat numerical values. For example, when the human being becomes the instrument of measure, say for softness of fabrics, plating lustre or the whiteness of paper, it is only natural that neat numerical figures such as one finds for size and weight are an impossibility.

Imagine for the moment that you are to determine the softness of several kinds of fabric. You cannot measure the exact softness, but by arranging the fabrics in order of softness, you can obtain excellent data.

As stated previously the purpose of collecting data and putting it in proper order is not to put everything into neat numbers but to provide a basis for action. The data itself can be in any form.

Generally data can be classified into the following groups.

1. Measurement data: computation values length, weight, etc.
2. Countable data: No. of production failures, No. of defects, reject rates, etc.

The statistical tools used in the analysis of data are:-

1. Histograms,
2. Pareto Charts
3. Cause and effect diagrams
4. Control charts
5. Scatter diagrams
6. Binomial probability paper, etc.

We shall look into only two important tools out of these, the control chart and the cause and effect diagram (Ishikawa Diagram).

The details of others are given in standard references.

Control Chart

This is a chart which detects changes in a production process. Fig. 1 is a histogram based on a measurement data collected five times a day at a textile plant. Fig. 2 shows a graph made using these data, showing the daily average value ($\bar{X}$) and daily range (R).

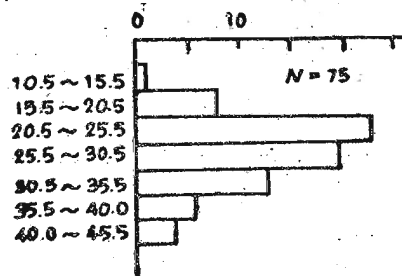


Figure 1 Frequency

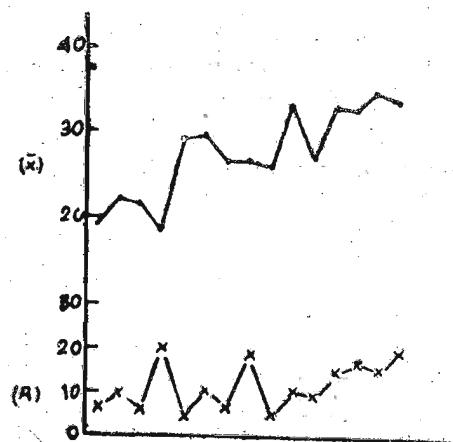


Figure 2

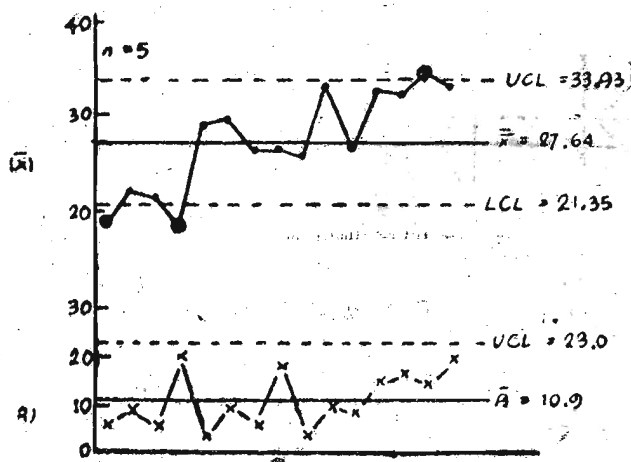


Fig. 3. Changes in Manufacturing Process

On the basis of this graph we can see that the values were low in the beginning and showed a tendency to increase over a period of time. By looking at the histogram in Fig. 1 we could not learn that fact.... In other words, the change of data gives us new information. Now, the problem is the determination of whether the points of the graph are abnormal or not. For example the first four points of the $\bar{X}$ might be normal or lower than normal. Thus, when the limits are not clear the graph is not of very much use. Therefore it is necessary to have some kind of limits within which $\bar{X}$ and R should fall, if the process is working under normal conditions. Control lines are written into these graphs for this purpose. If we add control lines to Fig. 2 we get Fig. 3. Now we can see where any abnormality lies and take action as required. A graph or chart with control lines on it is known as a control chart. There are three kinds of lines, the upper control limit, the central line and the lower control limit. They can be written as UCL, $\bar{X}$ or R and LCL.

Types of Control Chart

A control chart's form varies according to the type of data it contains. For example, part measurements, (mm) or masses (g) are measurable amounts (known as indiscrete values). Also there are reject numbers, or defect numbers, which are countable amounts (known as 'discrete values'). Control charts based on these two kinds will differ.

Type of data	Control chart used
Indiscrete Examples: measurements (say mm or g) volume (ml)	$\bar{X} - R$ $\bar{X} - R$
Discrete Examples: number of defects defect rate sub-standard product rate etc.	pn p

Reading of control charts

In order to use control-charts effectively we must know, how the changes in manufacturing processes are reflected on a control chart, i.e.

- When the manufacturing process is changed how do points on the control chart get changed?
- When the manufacturing process changes in degree, how is this reflected in the control chart?

These two situations are illustrated in the figures below.

- The $\bar{X}$ - R chart for the daily production of a certain product is shown in Fig. 4., let us call this distribution A. The manufacturing process in this factory is stable.
- When a factor (such as raw materials, machines, work methods, workers etc.) changes and consequently the mean value of a characteristic of the product changes. Fig. 5 shows the resulting distribution and the control chart.
- Now let us see what happens to the points on the control chart when the dispersion of the manufacturing process changes. The mean of the distribution remain as at A, but the dispersion becomes larger. this is shown in Fig. 6.

Now for the above situations, the $\bar{X}$ - R control chart shows:

Distribution A

- All points within the control lines and no clustering of points to one side of the central line. The manufacturing process is said to be in a stable state.

Distribution B:

- Points go outside the control lines in $\bar{X}$ chart although in the R chart the points lie within the control lines. There is clustering of the points in both charts. The shift from distribution A to distribution B is clearly shown on the control chart.

Distribution C:

- When the dispersion of the manufacturing process changes a large abnormality is seen on the R control chart. Also note that the spread of the points on the $\bar{X}$ control chart becomes bigger and goes beyond the control limits.

Thus the control chart is a very valuable tool in detecting abnormalities in a manufacturing process. (For further details see references). When abnormality of the process is shown on a control chart, the cause should be investigated and put right.

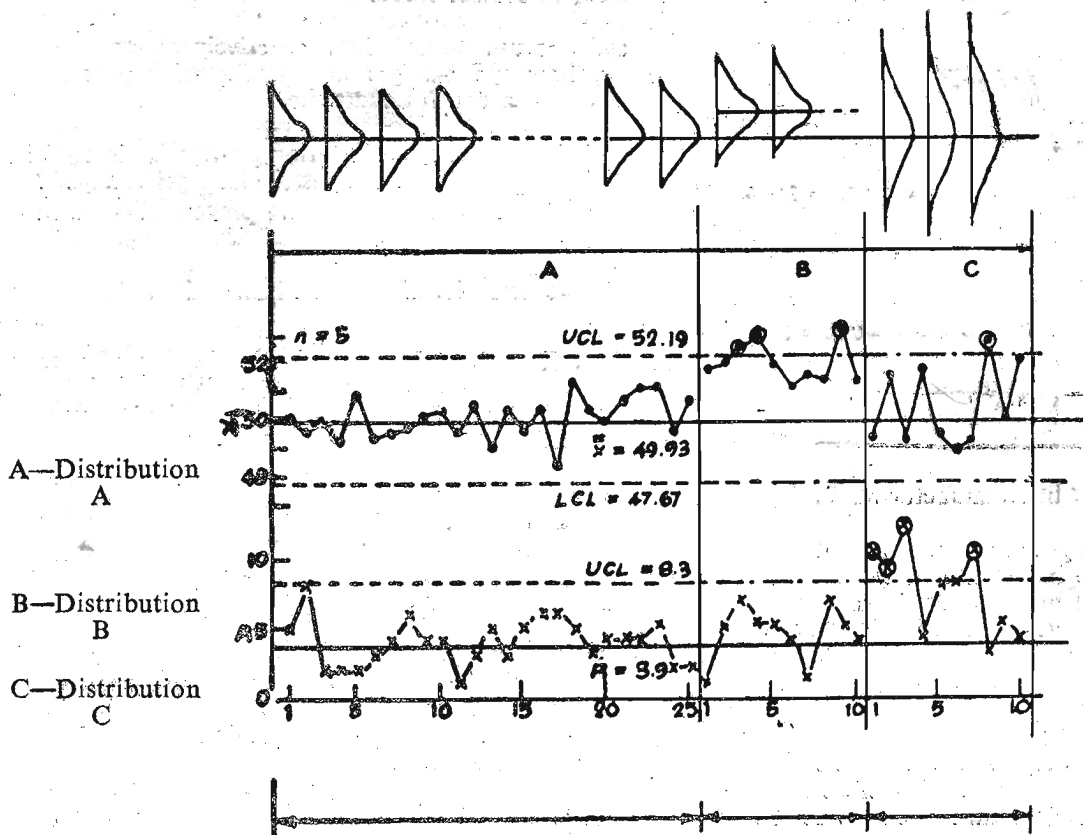


Fig. 4

Fig. 5

Fig. 6

Cause and Effect diagram (Ishikawa diagram)

This is a rather recent tool of statistical Quality Control, nevertheless it is a very useful tool. In this diagram all the causes that give rise to an effect are listed and the important and true causes are selected for further analysis. Fig. 7 shows a basic cause and effect diagram, for analysing the wobble of a spindle in a rotating machine. The diagram is developed in the following way.

Step 1 — Decide the quality characteristic (wobble during rotation) in order to stop the wobble we must find its causes.

Step 2 — Write the quality characteristic on the right. Draw a broad arrow from the left to the right.

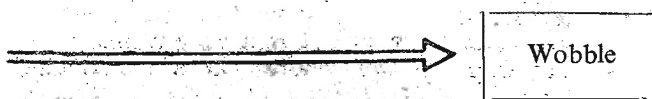


Figure 7

Step 3 — Write the main factors which may be causing this wobble along the arrow.

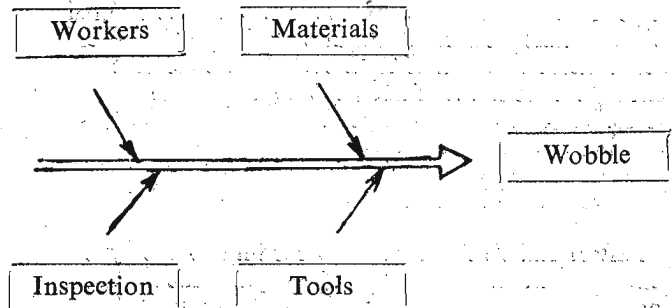


Figure 8

The four main causes have been grouped under: Workers, 'Material,' 'Tools,' and 'Inspection.'

Step 4 — Now, under each of these main reasons (causes) write in the components in detail. If you keep arguing in the following way you cannot help but find the cause of the problem.

1. Why do defects occur? Owing to machine wobble (dispersion)
2. Why does the machine wobble? Owing to dispersion in the materials. 'Materials' written on the diagram as a cause.

3. Why does dispersion in the materials occur?
Owing to dispersion in the axle sleeve. The axle sleeve becomes a subcause.
4. Why does dispersion in the axle sleeve occur?
Owing to dispersion in the size of the axle sleeve. Size becomes a sub-cause.
5. Why does dispersion in the size of the axle sleeve occur? Owing to dispersion at the 2.6 mm point. The 2.6 mm point becomes a sub-cause.

In this way we add to a cause and effect diagram until it fully shows the cause of the dispersion. Fig 9 shows the completed form.

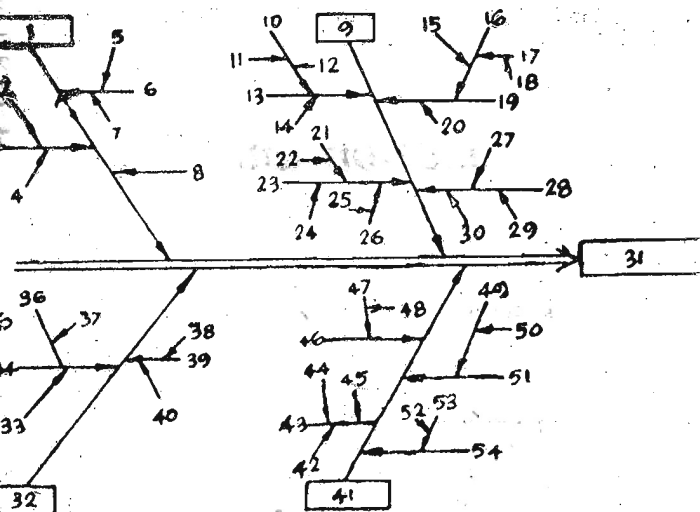


Figure 9 Cause and effect diagram

- | | | |
|----------------------|----------------------|-------------------------|
| 1. Worker | 19. G axle retainer | 37. Errors |
| 2. Content | 20. Material quality | 38. Training |
| 3. Training | 21. 11.6 | 39. Inspector |
| 4. Knowledge | 22. Uneven | 40. Experience |
| 5. Over-Experienced | 23. F cover | 41. Tools |
| 6. Experienced | 24. Axle hole | 42. Punch width |
| 7. Under-experienced | 25. 9 | 43. F axle cover |
| 8. Personality | 26. Interval | 44. Metal drill |
| 9. Material | 27. Threads | 45. Axle stop |
| 10. 6.4 | 28. Nuts | 46. G axle cover |
| 11. Small | 29. Tight | 47. Off centre |
| 12. Large | 30. Loose | 48. Adjustment |
| 13. Central axle | 31. Wobble | 49. Off centre |
| 14. Material quality | 32. Inspection | 50. Cover hole |
| 15. 2.6 | 33. Judgement method | 51. G axle sleeve cover |
| 16. Size | 34. Judgement | 52. Uneven |
| 17. 6 | 35. Measuring tool | 53. Plating |
| 18. Large | 36. Measurement | 54. F cover. |

Step 5 — Finally, one must check to make certain that all things which may be causing dispersion appear on the diagram. If they are all shown and the relationships are clear then the diagram is complete.

There are many varying methods for making cause and effect diagrams according to how one organises and arranges them. These methods can be divided into the following three types:-

1. Dispersion Analysis Type—

The cause and effect diagram which we just studied falls under this type. The secret of making it is to keep asking 'why does dispersion occur.?'

2. Manufacturing classification type—

With this method the diagram's main line follows the manufacturing process and all factors which may affect the quality are added. If Fig. 9 were written as a manufacturing classification diagram it would appear as Fig. 10.

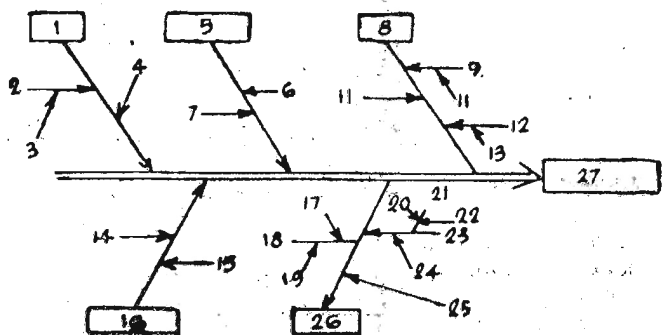


Fig. 10 — Cause and Effect diagram for wobble of a spindle (manufacturing classification type)

- | | |
|------------------------|--------------------|
| 1. Tools | 15. Cover |
| 2. Construction | 16. F resistor |
| 3. Design | 17. F cover |
| 4. Accuracy | 18. Cover caulking |
| 5. G. resistor | 19. Body G. |
| 6. Axle sleeve | 20. F |
| 7. Axle | 21. Axle sleeve |
| 8. Inspection | 22. G |
| 9. Measurement | 23. Axle caulking |
| 10. Measuring standard | 24. Axle |
| 11. Gauge | 25. Punch |
| 12. Judgement | 26. Assembly |
| 13. Person | 27. Wobble |
| 14. Axle hole | |

3. Cause Enumeration Type—

In this type all the possible causes are simply listed. When doing this, everyone's ideas are necessary and the use of a blackboard is helpful when listing the causes. These causes must be organised so as to show their relationship to product quality. In making this type of diagram, one has to remember not to confine one's thoughts to types of causes or assembly line order but think freely as one can. The real cause or the cure will come out of this kind of free thought.

A cause and effect diagram should fit the purpose for which it was drawn and be easy to use. There are several uses of them the chief ones among them being:-

- (a) Making a cause and effect diagram is educational in itself.
- (b) A cause and effect diagram is a focus for discussion.
- (c) The causes are aggressively pursued and the results are written in the diagram.
- (d) The data are collected with a cause and effect diagram.
- (e) A cause and effect diagram shows the level of ability of the workers and supervisory personnel.

Conclusions

The successful application of principles of quality control does not rest only on the Quality Control Department or the Inspection Personnel of the factory. These concepts have to permeate into every level of the organisation, right from the top management down to the production floor staff. It is the involvement and the consciousness for quality of all these personnel that could bring about a revolution in quality in the factory and thereby in the country.

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Standardization and Quality

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Although man has used all kinds of standards from very early times, standardization as an organized activity started with the Industrial Revolution which took place about two centuries ago. The implements used by primitive man as tools, exhibited striking similarity in materials, shapes and even dimensions. Archeological evidences indicate a great deal of standardization of clay bricks, pottery, earthenware seals and other products made in large numbers in the ancient sites of civilization in Babylonia, Egypt and Mohenjodaro which are dated about 5000 years B.C.

Standards of measure began when man found it necessary to estimate dimensions and distances for construction, food gathering and production. First he used standards nature gave him, namely his digits and limbs. For measuring objects and short distances he used such units as the breadth of the first joint of the forefinger, the palm, the span of the hand, the length of the foot, the forearm, and the distance between the tips of the fingers with the arms outstretched. For longer distances his measures were 'a day's journey'. These standards became integrated into many systems of measures which persisted for a long time in many parts of the world. The need to weigh came much later than the need to measure. It is known that the balance was first used for weighing precious metals for temple use or for the king and his governors. The earliest manmade weights which came down to us are cylindrical stone weights belonging to the archaic 'bega' system of Egypt and dating from about 1000 B.C.

The development of human speech as a means of communication of thought is another brilliant example of standardization achieved by the human race in the early days of civilization.

Standardization of products and processes in industry evolved towards the end of the 18th century when an American manufacturer, Eli Whitney, who is considered to be the father of mass production technique in the United States, made a very effective and large scale use of standardization for interchangeability. Whitney who received a large order for 10,000 muskets, planned to fulfil this large order by appointing an army of skilled workers each of whom produced one part of the product, which was thereafter assembled to form the whole instrument.

The modern phase of industrial standardization in the developed countries began when the Industrial Revolution brought about the factory system of production. The skill which earlier resided in the worker passed to the machine which produced, through repetitive operations, standardized products, the characteristics of which varied within certain pre-determined limits. As production increased, more and more products reached the consumer and the lack of dimensional interchangeability became a source of annoyance and wastage. Various types of nuts and bolts would not fit. Electric plugs and sockets of different makes, manufactured in the same country would not mate.

The first and second World Wars brought to the forefront the importance of international standardization. Particularly during the second World War, the supply and maintenance facilities of the Allies were severely strained because of different standards leading to lack of interchangeability of tools and common engineering stores. Complete workshop equipment had to be taken from the United States to European theatres of war at considerable cost.

National Standards Organizations were set up in a number of industrially developed countries during the early part of the 20th century. These organizations grew out of the need to co-ordinate, adjust and bring about economy and harmony in the existing patterns of industry which were quite confused. An International Federation of National Standardization Organizations was formed in 1926 which made great efforts to bring about unification of national standards. The work of this organization got disrupted at the out-break of the second World War and later ceased to function. The present International Organization for Standardization (ISO) was formed in 1946 by the representatives of some of the Standardization Organizations with the objective of promoting the development of standards in the world with a view to facilitating international exchange of goods and services and developing mutual co-operation in the sphere of intellectual, scientific, technological and economic activity.

Standards organizations in developing countries where the industry is far from being developed to warrant harmony and adjustment as in the case of developed countries, were set up for quite different reasons. These countries which had to operate within limited resources, faced with severe problems of processing the necessary raw materials, had to pre-plan the development of industry assisted by standardization. In the case of emerging countries like Sri Lanka where the economy has been based on primary agricultural commodities, standardization received attention much later with the development of the industrial sector.

However, the basic principles and purposes of standardization remain the same whether it is applied to a developed or a developing country. These are summarised in the ISO definition for standardization which reads:

"Standardization is the process of formulating and applying rules for an orderly approach to a specific activity, for the benefit and with the co-operation of all concerned, and in particular for the promotion of optimum overall economy taking due account of functional conditions and safety requirements.

It is based on consolidated results of science, techniques and experience. It determines not only the basis for the present but also for future development, and it should keep pace with progress."

A standard is the result of a particular standardization effort approved by a recognized authority. It may take the form of:

1. A document containing a set of conditions to be fulfilled.
2. A fundamental unit or physical constant (e.g. ampere, absolute zero, pascal etc.)
3. An object of physical comparison (e.g. metre, kilogramme, etc.)

A standard specification is a concise statement of a set of requirements to be satisfied by a product, a material or a process, indicating wherever appropriate, the procedure by means of which it may be determined whether the requirements are satisfied, and approved by a recognized authority. A standard may be prepared at a number of levels depending on the group of persons who are to use the standard. We may talk of a company standard used by a company, an association standard used by an association, a national standard used by a country, a regional standard used by a group of countries in a given region or an International Standard.

The aims of standardization in general are to achieve overall economy, protection of consumers' interests and safety and protection of health and life.

Overall economy comprises economy of human effort, materials and machines, power and energy. This also involves simplification, reduction of variety of products and components, elimination of avoidable waste during handling of materials, processing, transport and transport of goods.

Consumers' interests are looked after not only through the attainment of high quality or performance but also through non-material services such as the ready availability coupled with serviceability.

In the preparation of standard specifications for electric appliances, safety is ensured through the incorporation into these standards, of essential safety provisions. Installation and maintenance of electrical equipment are also covered under standard codes of practice to ensure safety. In the case of food items which can cause health hazards, standards stipulate the maximum permissible limit of toxic elements such as arsenic, lead, etc, food additives, bacteria and contaminants and thus help to protect health and human life.

Mass production of any industrial product necessarily focusses the attention of the manufacturer on mass distribution. Apart from the retail price of an article the other vital factor which determines the successful invasion of a permanent market is the quality of the article. This is particularly so in an industrially developed economy where the consumer has a wide variety of products to choose from. In emerging countries like Sri Lanka, the production of goods of minimal quality is conditioned by factors such as lack of adequate foreign exchange to procure raw material and testing facilities, necessary spare parts and in certain cases lack of technical know-how. Often there prevails a sellers' market as a result of which the manufacturer tends to disregard his social responsibility towards the consumer in providing goods of minimal quality. The situation should prevail only till the monopoly enjoyed by certain industrialists is removed by the establishment of more industrial units. Criteria such as raw material, chemical and mechanical requirements, dimensional requirements, performance, safety packing,

labelling, transport and storage which are spelt out in a standard, taken together determine the quality of an article. Standardization is therefore an important means of ensuring quality. The above only conveys a very vague picture of the term 'quality' but does not define it in precise terms. Attempts to define the term 'quality' have proved to be rather difficult.

A dictionary definition of quality given as the degree of excellence may not help very much in describing the quality of an engineering article. The European Organization for Quality Control (EOQC) first defined the term as 'fitness for purpose'. This definition was not successful because of its incompatibility with common usage. This would be evident when comparing an expensive Rolls Royce car built to last for many decades with a standard mass produced car produced with the expectation that it would develop troubles after a few years. The latter costs comparatively much less. Since both these makes of cars satisfy the demands of its own particular market i.e. 'fitness for purpose intended', both are quality cars. But this conclusion would not receive much support among the public. EOQC later modified this definition as 'the degree to which a product meets the requirements of the customer.' With manufactured products, quality is a combination of quality of design and quality of manufacture. The British Standards Institution gave the following definition: "The totality of features and characteristics of a product or service that bear on its ability to satisfy a given need." This definition too lacks precision and measurability and therefore as a base for an engineering activity is unsatisfactory.

Turning our attention back to standards we may define quality 'as conformity to an agreed specification.' This definition will help the customer in recognizing quality.

The means by which we achieve conformity to quality specifications is known as Quality Control. Thus Standardization and Quality Control go hand in hand, one being complementary to the other. Modern Quality Control is an effective system for co-ordinating the quality maintenance and quality improvement efforts of various groups in an organization so as to enable production at the most economical levels which allow for full customer satisfaction.

In some of the Western countries like the United States, statistical methods were used for the control of

quality in mass production. It was possible through these Statistical Quality Control methods to achieve the most efficient use of raw materials and the manufacturing process and to reduce the cost of production in turning out the maximum quantity of goods of standard quality.

Dr. W. A. Shewhart of the Bell Telephone Laboratories was the founder of the Statistical Quality Control Technique and Movement, which has now become an integral part of standards work in many countries which have achieved very significant progress in enhancing the quality of industrial products. In the pre-war period, Japanese goods had a bad reputation for cheapness, both in price and quality. Generally products "Made in Japan" had a poor quality image and received little customer's acceptance. The end of the Second World War witnessed a complete destruction of her industry. But soon she found herself on her feet once again. New knowledge techniques and practices of management were introduced in industry. It is through the application of Statistical Quality Control techniques that today Japanese goods can compare with the best from any country. The American educator and Quality Control specialist Dr. W. E. Deming after whom a number of Quality Control prizes offered in Japan, have been named, was largely responsible for the introduction of SQC techniques to the Japanese industry.

Realising the importance of Statistical Quality Control as a means of improving the quality of local products, the Bureau of Ceylon Standards organized Training Programmes to factory personnel both at the management and foreman levels. This is now a regular part of the Bureau's work which has been instrumental in training a large number of factory personnel in SQC techniques. Feedback information received from trainees show that satisfactory results have been achieved in a number of state sector and private sector organizations which had instituted methods of Statistical Quality Control. Through sustained efforts and consistent application of these techniques there is no doubt that the quality of our products will improve to the satisfaction of the consumer.

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Standardization and International Standards

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Standardisation is the process of formulating and applying rules for an orderly approach to a specific activity for the benefit and with the cooperation of all concerned, and in particular for the promotion of optimum overall economy taking due account of functional conditions and safety requirements. The development of science, technology, and experience is utilised in the process of standardisation. Thus standards determine not only the basis for the present but also for future development, and should keep pace with progress.

Standardisation in the modern world, in general, is mainly concerned with the simplification of the growing variety of products and procedures of human life, communications, overall economy, safety, health and protection of life, protection of consumer and community interests and the elimination of trade barriers. The usefulness of standards as a means of communicating ideas and technical data, and the role in the elimination of trade barriers between nations has been recognised. Advances in technology and the increase in the volume of goods passing between countries have created a demand for new up-to-date standards of international level.

Standards could be carried out at individual, company, national and international levels. Individual level standards were described as those specially laid down by an individual consumer or user, a builder or contractor, a government department or a corporate body, in fact, anyone to suit his own specific needs. Examples for this type of individual standards are the specifications for making a piece of furniture, a design for building a house or constructing a dam, or a project for erecting a bridge or a factory.

Company standards cover every aspect of the working of an enterprise, whatever may be the nature of its business. Thus it may deal with engineering standards, administration and financial norms, code of practice for manufacturing and maintenance, and even codes for conducting market surveys and estimating costs. The company standards cover those activities relating to any of the various activities of the enterprise whatever.

The most important of all levels of standardisation is the national level of standardisation. The national standards co-ordinate the lower levels of standardisation with the higher levels—the regional and international standards. It is at this level that the requirements of the individual, company and international levels are co-ordinated and integrated and purposetul national standards emerge, which serve as effective instruments for guiding the development of a nation's industry and commerce, bringing about order in the existing pattern of the national economy.

International standardisation which is the goal of standardisation, brings about understanding ultimate of all technical questions which are related to the exchange of goods and services between one nation and another.

During the first phase of national standardisation the primary effort of all national bodies was directed towards the preparation of product standards. The standardisation of products invariably require the adoption of a certain number of special terms or existing terms with a very special meaning.

A product standard deals with the performance, reliability and the outer appearance. It is therefore essential to know which of the characteristics are to be incorporated in the standard.

The dimensional standard generally means standardisation of the linear dimension of a product, such as length, width, height, diameter, etc. But it may include other characteristic features which can, in a broad sense be expressed by physical quantities, eg. weight carrying capacity of cranes, efficiency of motors or power of engines.

Dimensional standardisation is an important aspect of mainly all product standards. It is used for interchangeability, for reduction of types and sizes or to provide a general clarification by means of a standard, and for comparing products of different origin.

Safety in the use of a product is a matter requiring special attention. It safety is a principal aim of standards then characteristics necessary and sufficient to achieve safety should be selected and defined, and values for these characteristics should be selected. The methods of testing should be specified completely and mention be made as to whether or not the standard has to meet public safety regulations established by law or merely advise as to the best means of securing safety.

Standardisation results in the reduction of varieties and hence a reduction in production cost. If the customer wants reliable goods at the cheapest price, then he must be prepared to sacrifice some part of his individual demands. On the other hand, the needs of all people are not the same and too much limitation of variety would lead to a very dull and drab existence. In standardisation, the degree to which variety reduction can be applied is a compromise and each individual case has to be considered on its merits.

The contribution of standardisation on large — scale production, consequently, lower cost of production of manufactured goods in industrialised nations and for export on a world-wide scale will provide larger markets for the raw materials coming from developing nations. This will enable their people to afford and to purchase more of the manufactured products that go along with the higher standards of living that the inhabitants of developing nations wish and have a right to achieve. Production scales geared to international as well as national markets, with the minimum of necessary variation made possible by standards bring improved products into the grasp of more and more people.

An analysis of the role of international standards, will show that these can provide the means for more economic use of our shrinking world resources. They can offer protection against artificial trade barriers and pave the way for expanded international commerce and freer trade among nations. They can spare emerging nations unnecessary cost and effort in building up their national industries and in entering world markets. At the industrial level they can bring about unified market requirements providing better opportunities for the producers, large and small, and so provide more competitive optimum to users and consumers.

Another important role of international standards is that they would promote the safety and well-being of our populations, enhance our ecology and environment and facilitate the availability of the tools and technology which tackle the many problems facing our planet today.

The international standards are laid down by the International Standards Organisation. An International Standard is the result of an agreement between the member bodies of I.S.O. An International Standard may be used as such, or may be implemented through incorporation in national standards of different countries.

The activities of the International Standards Organisation came to the forefront in the sixties and one of the obvious reasons for this was the revolution in the transportation methods to cope with the growing international trade. Also the development of multinational companies which found their commercial activities hampered by conflicting national standards, the growing interest of governments in an international, technical platform, for the development of harmonized regulations, the creation of standards institutions in a number of developing countries, which realised the need for a sound international basis for their national work, the widening scope of I.S.O., which engage more and more people from different interest groups —not least the consumer movement and the recognition by other international organisations of the need for rules in technical questions, contribute to this situation.

The task of advancing the knowledge of both national and international standards and encouraging their use are normally entrusted to a national standards body. The main functions of such a body are the preparation

and promulgation of national standards, the promotion for the adoption and application of standards, quality assurance and certification of products, provision of means for disseminating information on standards and related technical matters, both national and international, and the representation of its country in international standards work. The active participation of the national standards organisation in the international discussions on standards work should be considered as a matter of high priority, because it not only enables them to influence final decisions, but also helps them to have their own peculiar needs duly reflected in the international standards.

The main activities of the International Standards Organisation is to promote the development of standards in the world with a view to facilitating international exchange of goods and services and to developing mutual cooperation in the spheres of intellectual, scientific, technological and economic activity. As a step in achieving this, the following procedures are adopted. By taking action to facilitate co-ordination and unification of national standards and issuing necessary recommendations to member bodies for this purpose, setting up international standards provided in each case no member body opposes, also to encourage and facilitate as occasion demands, the development of the new standards having common requirements for use in the national and international spheres and to arrange for exchange of information regarding work of its member bodies and technical committees and also to cooperate with other international organisations interested in related matters, particularly undertaking at their request studies relating to standardisation projects.

Present day international standards cover a very wide field. This field extends from graphic symbols, terminology and documentation paper and office equipment, photography, cinematography, industrial machinery, safety, consumer information, to quality of life, acoustics and time and space.

International standards covering vocabularies for paper and plywood, fire tests, and fishing nets, plastics and rubber, building and data processing have been formulated. A well designed symbol can convey clear cut image more quickly and surely than words. This is a particularly so in a multilingual situation—at an international air port for example—or when addressed to illiterate people. Various ISO Technical Committees have developed or adopted hundreds of carefully researched signs and symbols covering such matters as pipe line systems in ships and air crafts, handling instruction for cargoes, flow shut diagram for data processing equipment, road vehicle controls, etc.

Standardised paper formats are of immense use in the rationalization of the office routines. The ISO Standard on paper sizes published in 1975 is now used in almost all countries. Further implementation was achieved through the recent UN decision to adopt ISO sizes.

ISO standards also cover the dimension of envelopes, filling folders, address areas on post cards and specification for credit cards. In the related fields of paper pulp and board another six international standards were published in 1975. The publication of a series of ISO Standards on basic type writer keyboard arrangements for the Latin alphabet had tremendously simplified the key board operation and design, reduced operator training and facilitated staff exchanges across national borders.

International standards in the field of photography had removed the problem of obtaining the film rolls as these standards specify the relevant dimensions. Also these standards made it possible to screen films in any part of the world, produced anywhere, as the dimension of the cores in motion picture film rolls have been standardised internationally.

Modern industry could hardly function without the wealth of standards which are used routinely in so many spheres—welding, gears, refractories, technical drawings, compressors and making tools, to name just a few.

The number of safety codes published by ISO are adopted all over the world when assembling or operating continuous mechanical handling equipment. Also, the approved procedures for the manufacture, use and maintenance of safety clothing and equipment, rules for the construction of nuclear power facilities. Standards relating to tractors, earth moving equipment or road vehicles are also formulated. Among these the test method for frontal fixed barrier collision, and test methods for the mechanical and optical proportion of road vehicle safety glass are some of the international standards which cover the safety aspects.

ISO work in the field of consumer items play a vital role. Through the large number of ISO Standards on agricultural food products it has become possible to achieve a global harmonization of preservation and test methods, as well as quality specification relating to a great many of the food stuffs.

ISO work in the field of ergonomics which are concerned with the fundamental characteristics of man, the functional value of equipment, process, products and systems, the effects of physical factors of the environment on man, ergonomics test procedures and processing of ergonomic data.

Among other aspects which are covered by the ISO Standards which affect the quality of life are methods for testing air and water, engine performance and fuel filters for cars, sampling of radioactive particles and also it has been decided recently to study the standardisation of tests on quality of work places.

In 1975 International Standards were published on acoustics of auditoria and the standard musical pitch and also standards dealing with noise in the vicinity of railways, harbours and airports. A study of the effects of vibration on the human body is also undertaken by I.S.O.

International Standards which specify the characteristics of an internationally agreed atmosphere is intended for use in the design of flying vehicles and their components under identical conditions. Also the ISO technical committee on horology had issued standards on the optical, mechanical and radiation characteristics of the luminescent deposits fixed on time measurement instruments and the technical definition concerning gold alloy coverings for watch cases and their accessories in 1975.

In 1976 January there were 2836 available International Standards and in addition 1750 draft proposals had been registered by the ISO Central Secretariat.

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QUALITY CONTROL TRAINING CENTRE

A regional Centre to train industrial quality control officers in Asia is likely to be set up in Sri Lanka. In the past, Sri Lanka personnel were trained in quality control at the Centre in Rotterdam. Prof. J. Sietig from Rotterdam visited Sri Lanka recently in this connection and made a feasibility study of the project.

Quality Control of Food Products

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The history of the control of the quality of food can be traced far back to the early days of food production. From those early days, the manufacturer of food did assess the quality of food and attempted to maintain a high standard. In the ancient past, parameters of quality used to be measured on the basis of sensory evaluation i.e. by vision, taste, smell, touch, etc., and with the improvement of technology, instrumental measurement came in gradually. However, it is only in the recent past that quality control has been considered as a complete science by itself where a scientific approach has been made to exercise the control of quality.

In Sri Lanka, quality control of food is a neglected area. Except in a handful of industries, we still exercise the ancient methods of quality control restricted to sensory judgement of end-products. Scientific approach involving statistical methods of collecting data and interpretation of results are not being utilised sufficiently in our food industries. In order to achieve consumer satisfaction in quality in food, the subject of controlling of quality has to be considered as a distinct discipline and much more importance has to be given to this section of science. The management and workers in all food industries must realise that quality control is an important tool in gaining consumer-confidence in the products manufactured by them.

Quality Control — What is it?

When you talk of quality you always think of the consumer and his needs. In other words, the consumer is the ultimate decision-maker of quality. Quality in general is the sum total of all characteristics of a product as looked upon by the consumer.

The characteristics of a food item that reflects acceptability to the consumer are two-fold. The first category covers sensory characteristics such as appearance, taste and smell. The second category consists of hidden attributes which cannot be judged by sensory evaluation. These constitute the characteristics which if measured indicate wholesomeness or adulteration and harmfulness in a food.

The food manufacturer's aim should be to produce food which is easily marketable, and it is his task to see that his products are continuously bought by the consumers. For this reason he must be mindful of both categories of quality attributes mentioned above. He must give products which satisfy the senses of the buyer, but in the long run he must guarantee the wholesomeness and the purity of the product. If these two categories of attributes are looked after and the quality levels are maintained on both these categories then he could be satisfied that the consumers' needs have been met.

How to exercise Quality Control in Food.

Measurement of Quality

The food manufacturer must keep in mind the quality required by the consumer and then build up the quality required at every stage of manufacture including the basic raw material.

Many industrialists of food in Sri Lanka tend to believe that it is the end product that should be examined for quality. But this is totally a wrong conception. Quality is something that has to be built into the product through every stage of production. This being the case, quality control has to be applied from the initial stages of processing.

Many functions are involved in the implementation of quality control. These functions are briefly discussed below:

- (a) Establishment of Standards Specifications—
After thoroughly studying customers' requirements, production capacities and the cost factors, standards have to be laid down for raw materials, semi-finished products, finished products, methods of processing and practices to be followed.

Material standards must cover all characteristics that are directly or indirectly required to satisfy the consumer. These include all the necessary organoleptic requirements such as appearance, (even presence of insects, extraneous matter, etc.) colour, texture, odour and taste, etc. The requirements of these could be of a descriptive nature such as "characteristic odour of cardamoms" in the case of cardamom oil or can be of a reference type model nature, where reference is made to match with a type specimen, such as the colour of a reference sample in the case of tomato sauce. These organoleptic parameters should as much as possible be clearly defined to prevent ambiguity.

Given below are some important parameters for different groups of food items:

Fruits and Vegetables:

The emphasis on attributes differ very much depending on the end use. The important ones are wholesomeness, firmness, colour in different regions, odour and size and also the number of units per given mass.

Fruit Juices, etc:

Appearance, foreign matter, colour, physical stability, freedom from extraneous particles and flavour.

Cereals and Cereal Products:

Soundness, cleanliness, purity of the type, defectives such as damaged, shrunken and broken ones, dryness, size and hardness.

Meat and Meat Products, Marine Products:

Colour, odour, texture, flavour in the case of cooked ones, size and mass depending on the product and grade, number of pieces per given weight, type of cut, quantity of bone, shell etc., cleanliness.

Dairy Products:

Here the sensory attributes do not play a major role as those of composition and microbial—sanitary control are the decisive factors.

Spices and Condiments:

Flavour, colour, appearance, foreign matter, size, wholeness, insect and moulds.

Fats and Oils:

Colour, flavour, stability, consistency, clarity, viscosity and hardness.

Confectionery:

Odour, palatability, hardness, taste, consistency, insects and moulds.

Essential Oils:

Flavour and odour, colour and clarity.

The second important thing in a material standard is the hidden attributes which are characteristic of the product. These are parameters such as acidity, total solids, ash, protein, crude fibre, volatile matter, moisture, carbonations, fat content, and so on. These are the parameters from which the authenticity of the product can be ascertained.

The significant ones are listed below:

Fruits and Vegetables:

Bulk density, moisture, water insoluble solids, alcohol insoluble solids, soluble solids, acidity, crude fibre, juice extraction, salt, sugar, oil content, preservatives.

Fruit Juices, etc.:

Brix, acidity, sugar, viscosity, size of particles, titratable acidity, vitamins and minerals.

Cereals and Cereal Products:

Ash, acid insoluble ash, protein, wet-gluten, moisture and performance properties.

Meat and Meat Products, Marine Products:

Moisture, fat, protein, nitrites and nitrates, chlorides, pH, ash, sulphides and performance testing.

Dairy Products:

Moisture, fat, protein, casein, ash, milk solids (not fat), total solids, specific gravity, titratable acidity, lactose, viscosity, salt, phosphorus and chlorides.

Spices and Condiments:

Moisture, volatile oil, ash, acid soluble ash, starch, crude fibre, alcohol extract and filth.

Fats and Oils:

Refractive index, colour, melting point, solid fat index, free fatty acids, peroxide value, iodine value, monoglycerides, stability, smoke point, salt, and performance testing.

Confectionery:

Stability, sugar, preservatives, starch, milk and fat.

There are also some other parameters by which presence of certain substances which are injurious to consumers, could be judged. Some of these are the harmful elements like arsenic, copper, cadmium, mercury, zinc, heavy metals, and even pesticide residues in certain foods. Freshness in certain foods and freedom from spoilage are some of the primary characteristics the consumer looks for when he purchases a food item. A product can be spoiled at the raw material stage or it can get contaminated with harmful micro-organisms during any stage of processing. Whatever the cause may be, it is the manufacturer's responsibility to draw up standards to limit micro-organisms in order to have control on the extent of spoilage. Some of the common parameters are total plate count, viable count, E. Coli, Staphylococcus, Salmonella, Cl. perfringens, mould, etc. Material standards are not only required for the toxic product, but are also required for the items which get added to the basic product at some stage or the other. Even packing material has to be specified sufficiently. Standards for machinery and tools are also very important.

We have briefly discussed the type of material requirements for food under production. Specifications only for the product will not complete the necessary standards for a processing unit. During the course of production, various functions are involved and many practices are followed. Therefore, it is necessary that the methods for every stage of production should be well defined. Otherwise, if ambiguities arise it could finally end in an altogether different product in any manufacturing unit and specially in food industries—certain good practices have to be followed during the course of production. These practices are not only for the convenience and safety of the workers but are also important from the point of view of maintaining favourable conditions to arrive at a satisfactory product at the end of production. These are the handling, transporting, and other practices in a food industry. Most important is the hygiene. If this deteriorates it may lead to a situation where the entire factory may have to be closed down. Hygiene is very important for any

food factory and in many countries there is legislation to ensure that good hygienic practices are followed. Codes of practices have to be laid down for these. Standards are also required for methods of packing. Producing a very good quality food but with neglected packing will result in a complete loss to the manufacturer. This is a very sensitive line as far as the consumer is concerned. Packing is equally important as production, in the case of food.

Standards for marking are necessary and important because the consumer will be fully guided by the label which appears on the food item. Even in Sri Lanka there is legislation which makes it obligatory for any manufacturer of a food article to declare certain important factors to the consumer.

Standards established will not be complete if the other functions such as management procedures, codes of practice for workers, warehousing, sales, budgeting, inventory and other fields of this nature are neglected.

While setting up standards one has to take into consideration the regulations prevailing in the country and also those prevailing in other countries, if such food items are to be exported. In Sri Lanka, the saleable foods are covered by the Food and Drugs Act and the Regulations framed under this Act. For exports, certain food products are subjected to regulations of the Import and Export Controller and the standards laid down by the Bureau of Ceylon Standards.

(b) Methods of Testing

Once the standard specifications are established, the method of testing these specifications have to be drawn up. These will have to be clearly written to avoid ambiguities. Each test method must include details of apparatus, reagents, procedure, calculation and report of results.

(c) Checking of Quality

"Control" is to check if the process has been done in conformity with the ordered standard and deal with the unfavourable phenomena by corrective action.

In order to maintain the standard, the product in different stages must be checked for compliance with the standard. However, to conduct this supervision completely one cannot be assured unless he checks everything and the contents involved in every process. But such 100 per cent supervision not only costs a great effort but is a big loss because the goods are broken and consumed during tests and this makes it impossible to check all of them. Thus it becomes desirous to have some means to cut down this laborious testing.

It is at this stage that statistics come to our aid. Statistics helps us to cut down this extensive examination. An efficient sampling scheme drawn up statistically

could be used for determining the number of units and frequency of sampling and testing so that quality may be evaluated with maximum reliability at minimum cost.

Sampling methods and scale of sampling differ from product to product. It depends on the nature of the product. The sampling method should be statistically backed to ensure that the examination of sampling gives sufficient guarantee that the results give a good reflection of the quality of the entire lot under consideration.

In homogeneous food items where there is little variation, examination is easy as only a few samples may have to be drawn. However, there are many food items where sampling is fairly extensive. When samples are tested other statistical aids are used to interpret the results. Control charts form an important tool here.

The result of processing always has a variation. Causes which affect results of processes are numerous and we cannot control them 100 per cent. Here I would like to recall the temperature chart which we use in the control of our body temperature. In temperature charts, the temperatures are plotted several times a day and by studying the relations between these values and the normal value 37°C, we judge whether our body temperature is normal or not. Similarly, we collect data in food production and statistically determine the controlling limits. When the results of process are plotted on a chart, we can ascertain whether the production processes are maintained in a normal state or not.

(d) Corrective Action

If the process gives results going out of control, then corrective action has to be taken to eliminate the cause for changing the processes in a control state. There can be several reasons for a process to go out of control. These are:

1. Carelessness or lack of thought when workers have to work in compliance with the standard.
2. Lack of sufficient education or training to do so or misunderstanding of standards.
3. Inadequacy of standards.
4. Non-suitability of the raw, material or the production machinery going out of control.

Item 1 is the responsibility of the production worker but 2 to 4, the management has to solve.

The following steps are suggested as solutions:

- (a) Try to make the workers to work in accordance with the standards and a further revision of standards.
- (b) Re-educate the workers with consideration of possible errors in previous education or insufficient education. In many cases, you will find that inappropriate teaching is the cause.

- (c) In spite of repeated teaching the worker only continues to make errors due to carelessness. In a situation like this, you must consider personnel transfers and aptitude placements.
- (d) Revision of standards—A standard without revision is useless. Revise your standard if necessary until it becomes a document that can be implemented without any difficulty, of course without ignoring the consumers' need. Control is easier with this type of standard.
- (e) Change of objectives—Not only standards but sometimes objectives and aims are found impossible to accomplish and must be changed.

Quality Control Department

If quality control application is to be organized systematically, it will be necessary initially to establish a Central Quality Control Department. This should be a well recognized section having direct relations with every other department including that of research and development.

Education and Training

Even though quality control could be exercised by the establishment of a Central Quality Control Department in the organisation, it has to be mentioned here that quality is something that every person in the food industry has to contribute in some form or other to ensure that what is aimed is finally produced. The line workers, their supervisors and engineers must understand at their level what is exercised in order to attain quality.

They must understand how a control chart is drawn and what the production processes have got to do with the control charts. Therefore, they must know their basic statistics. They must know sampling, testing and reporting of results required for quality control. Special training and education required for this purpose has to be provided to every worker in the industry. In this way, the industry will benefit the most because it will establish in every worker what is called "quality mindfulness". This is a practice which is followed in some of the developed countries where this kind of practice has definitely shown results of quality upliftment in a very short period of time.

Quality and Safety

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Due to increasing consumer demands for reliability in products, successful manufacturers ensure that every aspect of quality and safety are satisfied by their products. This is very true of the more developed nations. Heavy competition has made them produce better quality goods with built-in safety precautions. In the developing countries, however, a certain standard of quality is often maintained but less attention is paid to the safety aspects of the processes of production which should be incorporated into the products themselves.

Quality and safety are both essential to produce a standard product so that the consumer would receive a reliable product for the price he pays. Though both these factors are essential and interrelated, it is possible to have a good quality product without any built-in safety precautions in it. But it is not possible to have safety precautions in a product of no quality. The quality of a product is not so much of its properties only, but it is also determined by the extent to which it is adapted or attuned to its use. In general usage the word 'quality' is used to designate the attractiveness or excellence of a product. Safety in a product means those precautions which have been taken to ensure that the user of the product is protected from possible injuries and hazards. Raw materials of the best quality and proper type often contribute to built-in safety precautions. Apart from the components used to

enforce safety standards in a product, special appliances may have to be added on to a product to make it safer to use. Therefore, safety in products covers the necessity of the best raw-material as well as special designs and built-in mechanisms.

In developed countries, where a choice of many similar products is available and where living standards are high, people tend to choose a better quality product if the price is not prohibitive. One would not choose a product at 50% less in price than a better quality product, if it cannot be used at least 50% longer than the more expensive product.

Today, the consumer is becoming more and more quality conscious. Not only the price but also the quality and reliability of a product is a decisive factor in successful marketing. The producer's interest lies in producing an article at relatively low cost that enables a large profit margin. The consumers' interest lies in readily available low priced products which have lasting quality and looks good. To integrate both interests quality control has to be directed to production. The consumer is not interested in the safety aspects of a product if it is not important in usage. For instance, there are no safety aspects which the consumer looks for when purchasing wearing apparel. On the contrary, the consumer interested in safety in a product will first

look into its safety aspects and quality later. For example, if he buys a safety harness to work on an electric post he would look into the built-in safety precaution in the product. An importer of local prawns would look into the safety standards aspects of production and packing as they would cause health hazards. A wearer of a motorcycle crash helmet would not purchase one made out of aluminium but would look for a safety standard tested product of fibre glass. Where safety is involved, quality is automatically present because the manufacturer could not enforce the safety standard in his products without the quality standard in both raw-materials and the finished product.

Quality being of a relative nature, does not exist in itself like safety. Quality is always connected with the purpose for which it is used. The product can be of excellent quality in regard to one purpose but of good quality with regard to a different purpose. When comparing a Statesmen Holden to a Mini-minor car our judgement is influenced by the criteria we apply with a view to the purpose we have in mind or by appreciation of specific properties. A large expensive quality car will not serve the purpose of shopping in a crowded area but it will suit the purpose of being chauffeur-driven to a state function. Therefore, quality has relationship directly to usage. Road safety-conscious motorists would purchase a car with as many

possible built-in safety precautions, such as collapsible steering columns, good road holding qualities, head-rests for front seats, safety wind-screens and a sturdy body to prevent injuries from roll overs.

It was once said that a product may be of good quality without any safety in it. Many cars are manufactured today of very good quality without additional safety precautions. Safety standards in the manufacture of motor vehicles are being strictly enforced during the past few years in all manufacturing plants. Under competition some manufacturers produce better and more attractive built-in motoring safety precautions than others, to promote their sales.

Quality and safety are inter-related and are both essential in the making of a good product. Quality and standards, too, go together. The enforcement of standards laid down by the Bureau of Ceylon Standards cover quality control. The Bureau of Ceylon Standards has taken steps, recently, to enforce quality products in the match manufacturing trade and in prawns and asbestos industries. Safety standards are also being imposed and enforced by the Bureau of Standards. The enforcement of these standards in quality and safety are very welcome in elevating the manufacturing standards in Sri Lanka which is now entering the export market in many new fields of manufacture.

Quality and Society

M. G. de Silva

President, Sri Lanka Society for Quality Control

To improve our standard of living, we all agree that we need greater and greater productivity. Quality is the most essential ingredient in productivity. Through proper applications of the science of quality assurance, industries could produce better products at reduced cost and thereby broaden the market share and finally get more profit.

The cost of living is a much discussed topic today and everybody is concerned as the living index continues to rise. Quality control, aiming to produce better products at reduced cost, would necessarily help to make the cost of living a more manageable problem.

Sri Lanka does not need maximum quality products at very high prices. Instead, she needs optimum quality products at reasonable cost. What is needed is a product or service which meets the needs of the user at the minimum possible cost.

Today, the average consumer expects quantity with quality and that too economically, and this is a challenge modern industrial management has to face. Quality control can certainly help to meet this challenge

successfully. Quality assurance is no longer an aid to management, it is now an imperative need for further productivity and profitability of commercial enterprises and indeed for the survival of nations. Today, we need management that lives and breathes quality, management that honours and respects quality. Quality thinking must emanate from the top if it is to permeate the whole organisation. If quality control is to make a significant contribution, management by direct and indirect means should encourage quality activities and provide the necessary climate for proper growth of quality as a vital function.

Quality control is a confidence necessary to ensure that a product or service meets the consumer satisfaction. The success of any manufacturer depends upon the establishment and daily renewal of consumer confidence. It is possible to fail in business even if the relative quality of the products is good. However it is not possible to continue in business if the product quality is poor unless one has a monopoly. At a time when the accent is on export promotion and

the establishment of our products in competitive world markets, the part that quality control has to play need not be over-emphasised.

As you will agree, Sri Lanka is currently undergoing what could be termed an industrial revolution and in this context, quality control is a revolutionary philosophy practiced by management. As we become more and more developed, there is a greater and greater need for quality. Hence it must be promoted by everybody right from top management to factory floor level. Consideration of quality is growing daily and the consumer is becoming more quality-conscious and is always seeking the best return for money. But how often does the consumer get the desired quality for the price he pays?

In spite of certain legislative measures, cheating the consumer is a large-scale daily occurrence. Adulteration of food products like milk, jaggery, chilly powder, coffee, just to mention a few, is at an unlimited scale and the consumer often gets half the quality he pays for more than half the time. Quite apart from getting appreciably less value for money, such adulteration could cause health problems as the daily health and safety of the common man depends upon the quality of manufactured products. One obvious reason for such cheating is scarcity. Therefore, the authorities must give priority to increased production of essential commodities followed by efficient distribution. Lack of properly organised consumer resistance is one of the main reasons why inferior products continue to thrive in the market. This country needs more efficient consumer organisations whose objective should be to:

- (1) Educate consumers,
- (2) Ensure that the consumer gets reasonable quality at reasonable price,

- (3) Communicate with industry about the wishes and needs of consumers.

The consumer could play an important role in the national promotion of quality control.

Hardly a day passes without consumer criticism of the quality of products available for sale. Razor blades, boxes of matches, soaps, are just a few examples. This is particularly so with regard to price control items. Price control of essential commodities is commendable. But price control alone without proper control of the quality has no value or does not achieve its objective. Price control is not the only answer to bring down the price or to stabilise the prices of essential commodities. To give the consumers a product at a reasonable price the authorities should take meaningful steps to improve productivity and also see that the manufacturer gets a reasonable profit without which no enterprise can continue.

One of the most important things that all of us can do is to inspire people by creating an environment where the concept of quality is respected and honoured. In the final analysis, quality is the product of a framework of mind. It is therefore rooted in human attitudes.

No one person cultivates his own food, weaves his own clothes or builds his own residence. All of us depend on other people for many things. We live in mutual support and for this reason we all have a stake in the quality of everyone else's effort. The very continuity of our daily lives is built around the continuity of numerous vital services: food, water, power, transport, communication, waste removal and many others. Therefore we can only paint a pleasant picture of the good life provided the dykes of quality hold fast. Therefore our continuity requires quality.

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THE PRODUCTION OF QUALITY INDUSTRIAL PRODUCTS

Practical problems in the production of quality industrial products are now being studied by the Bureau of Ceylon Standards. The Bureau has so far helped two corporations—the Ceramics Corporation (in the production of mosaic tiles) and the Textile Corporations to solve such problems.

These problems were brought up at the Bureau's training class in standard and quality control for managers and technicians in industries.

The Bureau has so far trained 200 persons at managerial and technical level in both public and private sector industries, in industrial and quality control.

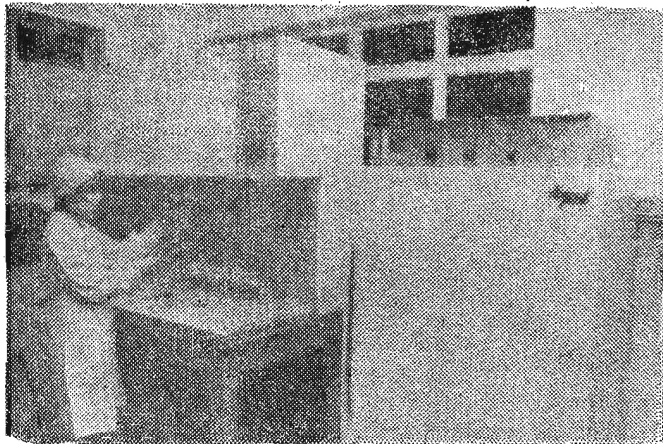
News

● NEW STANDARDS IN QUALITY CONTROL

Pfizer Ltd., of Ratmalana, the local operation of the large international Pharmaceutical manufacturer, have added significantly to the nation's pharmaceutical technology and potential for development with the introduction of the first Laminar Flow Work Station in Sri Lanka. This device provides ultra clean air, filtered such that particles of 0.3 microns (one micron is 1/1000 mm.) and larger are removed, thus eliminating practically all known bacteria. This makes it possible to conduct assay and other work with maximum accuracy.

When testing for the strength (potency) of certain vitamins such as Vitamin B₁₂, Folic acid and Calcium Pantothenate, microbiological assay techniques are used where the growth response of selected specific strains of micro-organisms is measured in suitable culture media in the presence of items under test. When testing the strength (potency) of antibiotics like Vibramycin (Doxycycline) the microbiological technique is used, but unlike for vitamins, here the degree of retardation of growth of the micro-organism is measured in the culture media, carrying the antibiotic.

Each specific substance requires the use of a specific type of micro-organism. Hence, it is absolutely essential that testing must be done using special techniques so as to prevent contamination with air-borne foreign micro-organisms. In modern laboratories today, this work area is provided with a contamination controlled working chamber known as the Horizontal Laminar Flow Work Station, which is kept "clean" by filtered air, continually flowing from a vertical wall and entirely displacing the normal contaminated air. This unit is also used during the sterility testing of injectables to ensure that all injectables manufactured are not contaminated with bacteria or moulds.



Pfizer have traditionally placed maximum emphasis on quality and now have probably the best equipped Quality Control Laboratory in Sri Lanka. Equipment used includes ultra-violet Spectrophotometer, Fluometer, Aquatitration and Turbidity meters and Incubators.

All of this, contributes towards an exact analysis of both raw materials and finished products necessary to produce a dependable, consistently high quality pharmaceutical product.

● SRI LANKAN DELEGATION ON "TRANSFER OF TECHNOLOGY"

A technological delegation on "Transfer of Technology" visited India in April, 1977, on the invitation of the Government of India. The main purpose of the visit was to identify in broad terms Indian technologies which would be appropriate for use in Sri Lanka and also to make the Indian authorities aware of some technologies that Sri Lanka may be able to offer them. Another purpose was for the Sri Lanka delegation to get acquainted with some of the technological developments that have taken place in India in recent years. The visit was made under the India-UNIDO agreement on the transfer of technology.

The following delegation was appointed by the Government of Sri Lanka for this visit:

Dr. G. C. N. Jayasuriya, Secretary-General, National Science Council of Sri Lanka—head of delegation.

Mr. S. F. Laurentius, Director, CISIR.

Dr. S. Gnanalingam, Head, Applied Physics and Electronics Section, CISIR.

Mr. R. M. P. Jayaratne, General Manager, National Engineering and Development Centre of Sri Lanka.

Mr. N. B. F. Bhareti, General Manager, Industrial Development Board.

Separate programmes were arranged for individual members of the delegation so that each member would have the opportunity to acquaint himself with areas of Science and Technology, relevant to his own training and background. At the conclusion of the tour, the Sri Lankan delegation had discussions with Prof. Y. Nayudamma, Secretary to the Government of India and Director-General of the Council of Scientific and Industrial Research and officials representing various institutions concerned with Science and Technology in India. Possible areas for Technology transfer and collaboration were discussed. The delegation's final report has been submitted to the Ministry of Industries and Scientific Affairs.

● AMERICAN PATENTS FOR SRI LANKAN INVENTIONS

Dr. R. L. Wickremasinghe of the Tea Research Institute has been granted a patent of the United States of America for his invention of a process of making cold water soluble tea concentrates and powders. The method concerns the preparation of soluble tea concentrates and powders, particularly tea powder and

cold soluble tea concentrates which are sediment and "cream" free and are thus suitable for use in iced beverages.

It has been customary hitherto to prepare cold soluble tea powders or sediment free concentrates suitable for use in iced beverages, by making hot water extracts of made tea or fermented tea leaves and cooling the same to a temperature of approximately 4° to 10°C to precipitate the cream which is then removed from the supernatant liquid. Alternatively, insoluble protein or other polyphenol absorbants are added to the extracts in order to remove part of the oxidized polyphenols responsible for cream formation. The residual liquor is then concentrated to a syrup of desired consistency or dried to a powder.

These processes suffer from the disadvantage that the sediment free concentrate or dry powder yields a brew which does not reproduce the taste and strength associated with conventional black tea brew, because the cream or oxidized polyphenols removed in these processes are precisely the constituents which provide tea with its characteristic taste. Such teas are therefore described as "flat".

Dr. Wickremasinghe's invention provides a new and economical method for preparing cold soluble tea concentrates and powders, wherein the cream has been eliminated therefrom without removing the constituents which provide tea with its characteristic flavour.

The disadvantages in preparing tea extracts have been avoided by the selective removal of non-phenolic compounds of high molecular weight, such as proteins,

polypeptides and polysaccharides and by processing the resulting extract in the conventional way to obtain tea concentrates or dry powders.

By this method, cold soluble tea concentrates are manufactured by preparing tea extract by extracting tea leaves with hot water, selectively removing non-phenolic compounds of high molecular weight while retaining the phenolic compounds and then concentrating the resultant extract to obtain a tea concentrate or powder.

Mr. Leonard G. Wirasinghe who is attached to a leading engineering firm in Colombo invented a method for the prevention of sand-bar formation at outlets into the sea or other bodies of water. He has now obtained official recognition of his invention by the US Department of Commerce, Patent and Trade mark Office in Washington D.C. Patents are pending in Sri Lanka, the U.K., Australia, etc. The invention is a breakthrough on a universal problem which has an impact on irrigation, agriculture and the environment in general.

According to the Australian Patent Attorneys, "Other methods have been devised to overcome the problem such as by maintaining the through passage by mechanical dredging means or by creating and maintaining an artificial current by pumping to increase the velocity of the flow through the channel. While these methods are successful, they are expensive to operate and the installation is complicated and requires constant attention". They acclaim **Mr. Wirasinghe's** invention as the simplest, cheapest and the best method known so far.

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SEMINARS

● INTERNATIONAL SEMINAR ON ENVIRONMENTAL POLLUTION

24th March, 1977.

An International Seminar on Environmental Pollution was organised by the Atomic Energy Authority of Sri Lanka with the assistance of the IAEA, FAO and SIDA and held at the Sri Lanka Foundation Institute on the 24th March.

Professor F. P. W. Winteringham of the International Atomic Energy Authority, addressing the seminar, said that "It is not too soon for all countries whether they are highly industrialized or not, to take action to control pollution". Speaking on agrochemical pollution, Prof. Winteringham said that more and more food had to be grown on less and less land today, in order to feed the rapidly growing world population. Artificial inputs were necessary to obtain better yields from improved varieties of crops, but the pollution aspect had to be carefully studied, if the environment was not to be seriously damaged.

The guest speakers who addressed the seminar on various aspects of pollution on Sri Lanka included Prof. P. P. G. L. Siriwardene, Vice-Chancellor, Dr. G. C. N. Jayasuriya, Secretary-General, National Science, Council of Sri Lanka, Mr. E. E. Jeyaraj of the CISIR, Prof. H. H. Costa, Dr. Granville Dharmawardene of the University and Dr. P. V. C. Pinnagoda of the Ministry of Labour. Problems of industrial and biological pollution, pollution and power, and pollution and health were discussed at the seminar.

Several foreign participants spoke about the pollution problems in their own countries — Turkey, Bangladesh, Burma, Iraq, Brazil, El Salvador, Korea, Kenya and Switzerland.

● ANNUAL MEETING OF THE SOCIETY OF QUALITY CONTROL

27th April, 1977

The annual meeting of the Society of Quality Control was held at the Sri Lanka Tea Board Hall. Prof. P. P. G. L. Siriwardene, Vice-Chancellor,

University of Sri Lanka in his inaugural address, said that the society had the responsibility of building quality consciousness among industrialists, the workers on the assembly line and consumers. It is a disturbing feature today, he said, that under cover of import substitution some manufacturers were putting out new products, particularly food products, which were injuries to the health of the public. The society should aim to check this type of malpractice by educating manufactures on the need for maintaining standards, particularly in such products as jams, jellies, cordials, pickles and chutneys.

Mr. M. G. de Silva, President of the Society, announced that the society would set up a Consumer Service to investigate complaints made by the public about sub-standard goods.

Some of the recommendations made at the meeting were:

- A developing country like Sri Lanka did not need maximum quality products at very high prices; what they needed was optimum quality products at reasonable cost. The average consumer expects quantity with quality at a reasonable cost, and all efforts must be utilised to meet that end.
- To give the consumer, a product at a reasonable price, the authorities in charge should adopt measures to improve quality and productivity and, at the same time, ensure that manufacturers made a profit.
- Quality thinking and quality innovations, could reduce the cost of living and simultaneously improve the quality of life.

● WORKSHOP ON SCIENTIFIC & TECHNICAL INFORMATION

20 — 21 May, 1977.

A Workshop on Scientific and Technical information organised by the National Science Council was held at the auditorium of the Headquarters of the Sri Lanka Association for the Advancement of Science. Mid-level library personnel participated in the workshop which was the first of its kind to be held by the Information Centre of the National Science Council as part of its training programme. At present there is a definite dearth of facilities for training of mid-level library personnel.

The workshop was designed to:

- Introduce participants to new developments and practices in storage, retrieval and dissemination of information.
- To create an awareness of the information requirements of Scientific and Technical personnel.
- To help participants re-orient their approach to information work.

The workshop was conducted by means of lectures and discussions followed by practical work.

The programme comprised lectures on:

- (1) **Information requirements of Scientific and Technical personnel**—Dr. R. L. de Silva, Pathologist, Tea Research Institute.

Dr. Silva stressed on the importance of keeping scientists informed of ongoing research in individual and allied fields of interest. He emphasized the need to obtain information on research done in South and South-east Asia because of its greater relevance to our scientists than research in the more advanced Western countries.

- (2) **Information for Management**—Malkanthi Nanayakkara, Librarian, Marga Institute.

The aim of the lecture was to broaden the participant's view of the importance of feeding information to management/decision-making persons. The communication link that should exist between the library's management and the overall management for the efficient working of the organisation was also discussed.

- (3) **Recent developments in Information storage and retrieval**—M. A. P. Senadhira, Senior Assistant Librarian, Medical Faculty; Colombo Campus. Emphasis was laid on new techniques and their usefulness in the field of Scientific and Technical information in Sri Lanka. A detailed description was given of the computer and computer-based bibliographical information systems.

- (4) **Sources of Scientific / Technical Information**—Malani Wijesinghe, Assistant Librarian, Colombo Campus.

Information sources for the Biological Chemical, Agricultural and Medical Sciences were discussed. Participants were provided with an opportunity to familiarise themselves with information sources such as Chemical Abstracts and Current Contents.

- (5) **Sources of Scientific / Technical Information II**—S. Rupasingham, Librarian, Katubedde Campus.

Information sources in Technology and allied fields were described.

- (6) **Dissemination of Information**—Manil Silva, Deputy Director (Establishments), Central Bank. Methods of obtaining information ranging from personal contact, use of Institute's grapevine and meeting at conferences to the highly organised Selective Dissemination of Information were discussed.

An exhibition of Sri Lanka publications on Librarianship and Documentation and also of publications which serve as channels for the dissemination of information was held in conjunction with the workshop. The exhibition was aimed at creating an awareness of services already available in Sri Lanka.