SALT TASTER

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DECLARATION

I hereby declare that this project is my own work, except for certain quotations and reference that have been duly cited.

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ABSTRACT

This project is carried out to build a salt taster that to detect the approximate level of salt contained in a liquid food. The three-level LED in this circuit is used as an indicator, that to differentiate the level of salt containing in food from the illumination of LED. The salt taster is created using a self-made probe which made from two metal sticks that cut from the paper clip as a detector to test the salt level in liquid. There are two experiments has been done to test on the functionality of salt taster, that is experiment testing on the salt solution that salt dissolved in distilled water. And, the next experiment was testing on the light Soya sauce with distilled water. In addition, examination of liquid food also has been done to obtain the test result. The three-level LED that are green LED, yellow LED and Red LED can be found in the circuit which represent the salt level where is low, normal and high respectively. Hence, when the probe is immersed into the liquid solution, the illumination of LED is indicated the salt level of the solution. A food experiment has been done that is noodles-in-cup of curry flavour and vegetable flavour were taken to be tested of its salt level. It was found that the two flavours of brand A and brand B is at normal salt level while brand C is at high salt level. When the test result is the illumination of red LED, it is means that the salt level is at high and ones should take caution of the intake of salt to prevent from illness.

ABSTRAK

Projek ini dijalankan untuk membina satu litar penguji garam. Penguji ini digunalkan untuk menguji tahap garam yang terkandung dalam makanan cecair. Tiga tahap LED digunakan sebagai tanda isyarat untuk membezakan tahap garam dalam makanan cecair tertentu dengan penyalaan warna LED. Satu penduga yang dibuat daripaa dua besi yang dipotong dari klip kertas sebagai alat penguji. Dengan ini, dua experimen telah dijalankan untuk menguji kefungsian litar penguji garam. Dua experimen ini termasuk menguji air garam dan air kicap Soya cair dengan mencairkan garam dalam air suling serta mancampurkan kicap Soya cair ke dalam air suling yang disediakan. Di samping itu, beberapa makanan cecair juga diambil untuk menjalankan experimen tersebut. Tiga tahap LED itu termasuk LED hijau, LED kuning dan LED merah yang mewakili tahap garam berada di tahap kurang masin, normal dan tahap masin masing-masing. Oleh itu, apabila penduga tersebut dimasukkan ke dalam cecair yang hendak diuji, LED tertentu akan dinyalakan untuk memberikan isyarat tentang tahap garam dalam makanan itu. Satu experimen makanan telah dijalankan iaitu menguji mee cawan perasa kari dan perasa sayur. Didapati bahawa jenama A dan janama B bagi dua perasa tersebut adalah berad di tahap normal manakala jenama C berada di tahap masin.

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Ω	ohm
°C	Celsius
F	farad
L	length
C	capacitance
R	resistance
R_F	resistance reference
T	time
V	volts
Vcc	voltage source in Volt
V_{out}	output voltage
V_{in}	input voltage
V_{ref}	voltage reference
V_{sat}	voltage saturation
Z	Impedance
GND	Ground

CHAPTER 1

INTRODUCTION

1.1 Introduction

Salt, which also called Sodium Chloride is an essential element in the diet of not only humans but of animals, and even of many plants. It is one of the most effective and most widely used of all food preservatives (Roberts, 2000). It is a clear, brittle mineral that contains the elements of sodium and chlorine. Salt forms clear, cube-shaped crystals. Impurities can cause salt to appear white, gray, yellow, or red. Tablet salt also appears to be white. In food preparation, salt is used as a preservative or as a seasoning.

Every meal we taken everyday contain the content of salt in food that to give a taste for us in order to have a more tasty food. Every cell of our body contains salt. An adult human body contains about 250 grams to maintain the normal volume of blood and digest food (Kurlansky, 2001). If a human taken too much of salt will have an unhealthy body, especially to those who lack of exercise and obesity person. And it finally will cause High blood pressure or hypertension. Without salt, our bodies cannot function. Sodium depletion is usually associated with dehydration as, when we overheat, we lose water and salt through sweat. Failure to replenish the salt can be harmful. In order to lead a healthier lifestyle, we should know the content of salt taken is suitable for us. So, a system need develop by using a detector or called sensor. For instance, a salt taster is used to detect the salt level containing in food.

Salt taster is a detector that can test salt level containing in liquid food. This system is using a probe, which make by two metal sticks and soldered to the specific wire cable. By immersed the probe in the liquid, the 3-level LED will illuminate accordingly to the level of salt containing in food (red LED- high, yellow LED- normal, green LED- low). ICs, as low power quad op-amp are wired to the LED to differentiate the level of salt.

1.2 Project Purpose

In order to lead a healthier lifestyle, we should take cautions of our daily meal. This is because over consumption of salt can increase the risk of health problems, including high blood pressure. So, this project is carried out to build a circuit that to detect the amount of salt contained in liquid foods. Three-level LED in this circuit as the indicator.

1.3 Project Objective

i. To design a circuit to detect the approximate level of salt contained in a liquid.

ii. To test the functionality of the circuit.

iii. To differentiate the level of salt containing in food from the illumination of LED.

1.4 Project Scope

A self-made two metal sticks which are the metal cut from the paper clip used as probe to test the salt level of the samples. Cooking salt and light Soya sauce are used to undergo the experiments. Distilled water will is added into the salt and light Soya sauce to dissolve them as a testing solution.

1.5 Hypothesis

When the salt content of the liquid under test is very low, NO LED will illuminate.
When the salt content of the liquid is low, GREEN LED will illuminate.
When the salt content of the liquid is normal, GREEN LED will illuminate.
When the salt content of the liquid is high, RED LED will illuminate.

CHAPTER 2

LITERATURE REVIEW

2.1 Salt – Sodium Choride

We are familiar with sodium chloride as table salt. It is a typical ionic compound, a brittle solid with a high melting point (801°C) that conducts electricity in the molten state and in aqueous solution. The arrangement of Na^+ and Cl^- ions in the solid state is shown in Figure 2.3(a).

One source of sodium chloride is rock salt, which is found in subterranean deposits often hundreds of meters thick. It is also obtained from seawater or brine (a concentrated NaCl solution) by solar evaporation. Sodium chloride also occurs in nature as the mineral halite (Figure 2.1).

Sodium chloride is used more often than any other material in the manufacture of inorganic chemicals. World consumption of this substance is about 150 million tons per year. As figure 2.2 shows, the major use of sodium chloride is in the production of other essential inorganic chemicals such as chlorine gas, sodium hydroxide, sodium metal, hydrogen gas, and sodium carbonate. It is also used to melt ice and snow on highways and roads. However, since sodium chloride is harmful to plant life and promotes corrosion of cars, its use for this purpose is of considerable environmental concern.

Figure 2.1 The mineral halite (NaCl) (Chang, 1994)

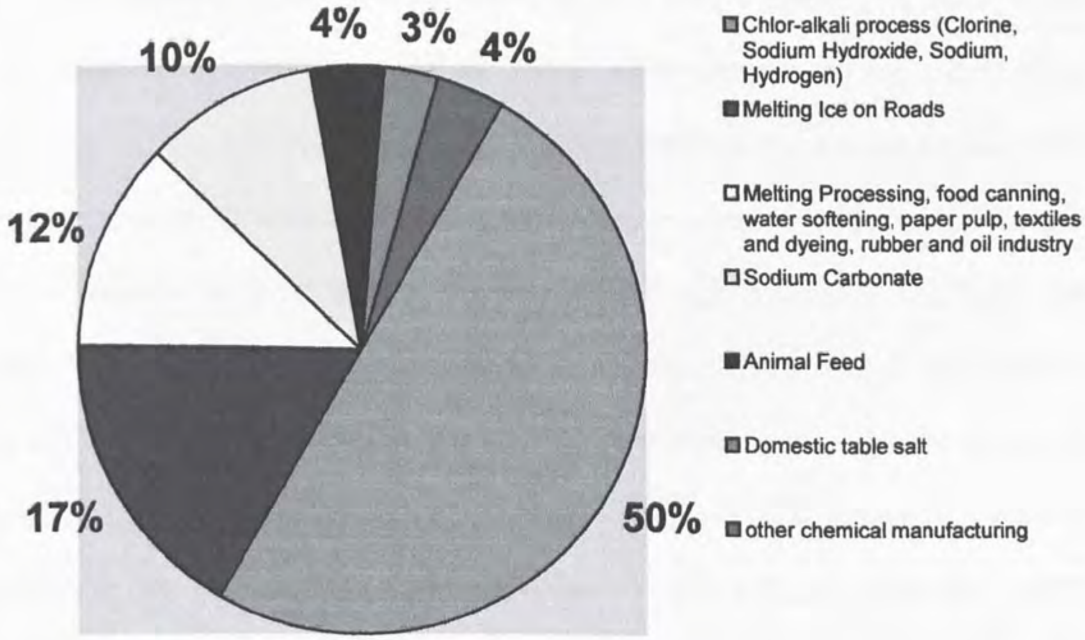


Figure 2.2 Uses of sodium chloride (Chang, 1994)

2.1.1 Salt for Human Nutrition

Human nutrition is a major market for salt because salt is an essential component of the human diet.

Sometimes the two terms, "salt" and "sodium" are used interchangeably, but technically this is not correct. "Salt" is sodium chloride. By weight, it is 40% sodium and 60% chloride. Sodium is an essential nutrient, a mineral that the body cannot manufacture itself but which is required for life itself and good health. Sodium is easily absorbed and is active in the absorption of other nutrients in the small intestine. Sodium is the major extracellular electrolyte responsible for regulating water balance, pH, and osmotic pressure. It is important in nerve conduction. Because of sodium's importance to your body, several interacting mechanisms guard against under-consumption of salt and its threat to your body's nerves and muscles and interference with the sodium-potassium "pump" which adjusts intra- and extra-cellular pressures. If your salt intake varies widely, these mechanisms activate to assure that your body remains healthy, maintaining a relatively constant blood pressure. Chloride, too, is essential to good health. It preserves acid-base balance in the body, aids potassium absorption, supplies the essence of digestive stomach acid, and enhances the ability of the blood to carry carbon dioxide from respiring tissues to the lungs. Salt should be part of every family's food storage program. Salt has been a valuable weapon in our public health campaign against iodine deficiency disorders (IDD), iodizing salt has virtually eliminated IDD in North America and many other areas although the World Health Organization has targeted elimination of IDD globally as a top priority. Where public health authorities do not fluoridize water, adding fluoride to salt is common as in France, Switzerland and Latin America.

Years ago we thought that different societies have wide variations in salt intake. Current research shows that where salt is readily available, the vast majority of the world's population chooses to consume about 6-10 grams of salt a day. Including naturally occurring sodium in foods, people worldwide consume about 3,500 milligrams (mg) of sodium, Americans included. Some remote primitive peoples like the Yanamamo Indians of the Brazilian jungle who lack ready access to dietary sodium do have almost unbelievably small levels of sodium intake–far below that judged by the National Academy of Sciences to be safe for Americans. But for the rest of the world, our average intakes are typical. The National Academy of Sciences considers 1,500 mg/day of sodium an "adequate intake." The European Union Population Reference Intake for males aged 18 years (an "acceptable range of intakes") is 575-3500 mg. Nutrition is important to good health. Salt is part of a healthy diet. Besides being an essential nutrient and a popular taste, salt adds life and joy to our foods.

2.1.2 Ionic Solid of Salt

A solid sample of sodium choride (NaCl) consists of an equal number of Na^+ and Cl^- ions arranged in a three-dimensional network (Figure 2.3a). In such a compound there is a 1:1 ratio of cations and anions, so the compound is electrically neutral. As you can see in figure 2.1a, no Na^+ ion in NaCl is associated with just one particular Cl^- ion. In fact, each Na^+ is equally held by six Cl^- ions surrounding it, and vice versa. (Chang, 1994)

To visualize this structure, first imagine Cl^- anion and Na^+ cations organized separately in face-centered cubic (cubic closest packing) arrays. The crystal structure arises when these two arrays penetrate each other such that the smaller Na^+ ions end up in the holes between the larger Cl^- ions. (Silberberg, 1996) Figure 2.3b is a space-filling depiction of the unit cell showing a face-centered cube of Cl^- ions with Na^+ ions between them. Note the four Cl^- $[(8 \text{ x } \frac{1}{8}) + (6 \text{ x } \frac{1}{2}) = 4\ Cl^-]$ and four Na^+ $[(12 \text{ x } \frac{1}{4}) +$ 1 in the center $= 4\ Na^+]$, giving a 1:1 ion ratio.

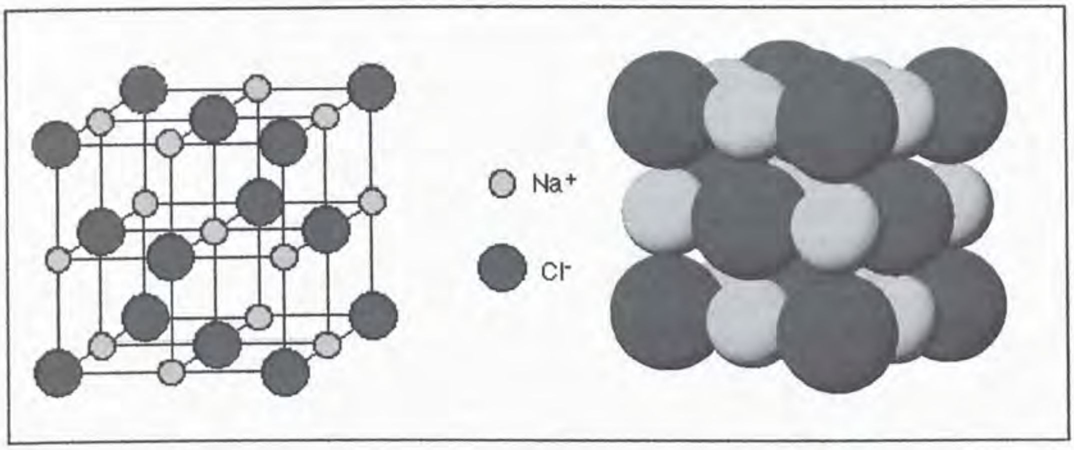
In other ionic compounds the actual structure maybe different, but the arrangement of cations and anions is such the compounds are all electrically neutral. Like NaCl, the actual formulas of these compounds are always identical to their empirical formulas. (Chang, 1994)

The molar mass of an ionic compound is the sum of the molar masses of the cations and anions present. Thus the molar mass of NaCl is given by

Molar mass of NaCl = molar mass of Na^+ ion + molar mass of Cl^- ion

= 22.99 g + 35.45 g

= 58.44 g



a b

Figure 2.3 (a) Structure of solid NaCl. (b) A space-filling view of the NaCl unit cell, which consists of four Cl^- ions and four Na^+ ions. (Chang, 1994)

2.1.3 Salt in Aqueous Solution

All solutes in aqueous solution can be divided into two categories: electrolytes and nonelectrolytes. An electrolytes is a substance that, when dissolved in water, results in a solution that can conduct electricity. A nonelectrolyte does not conduct electricity when dissolved in water. An electrolyte produces ions in solution, while a nonelectrolyte does not. (Chang, 1994) Figure 2.4 shows an easy and straightforward method of distinguishing between electrolytes and noneleclytes. A pair of platinum electrodes is immersed in a beaker containing water. To light the bulb, electric current must flow from one electrode to the other, thus completing the circuit. Pure water is a very poor conductor of electricity. (Silberberg, 1996) However, if we add a small amount of an ionic compound such as sodium chloride (NaCl), the bulb will grow as soon as the salt dissolves in the water. When solid NaCl dissolves in water, it breaks up into Na^+ and Cl^- ions. The movement of Na^+ ions toward the negative electrode and

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