BBC Bitesize - Chemistry

Episode 3 – Salt formation

TULELA: I'm Tulela Pea, a science communicator and podcaster.

SUNAYANA: And I'm Dr Sunayana Bhargava, scientist and poet.

TULELA: And this is Bitesize Chemistry. This is the third episode in an eight-part series on chemical changes. In this episode we're going to look at salt formation and naming. Not just sodium chloride, the salt you put on your chips, but all sorts of other salts nearly all of which you definitely do not want to put on your chips!

SUNAYANA: Will we look at how acids react with metals to produce salts?

TULELA: Yes, indeed we will! As well as how acids react with metal hydroxides, metal oxides and metal carbonates to produce salts.

SUNAYANA: And we'll look at how we name those salts and how we can crystallise salt solutions to produce solid salts.

TULELA: And as always we'll round it off with a quick quiz and summary of all the most important facts. Ready with your pen and paper to make notes?

SUNAYANA: And hit pause and rewind when you need to, to have a little more time to let those key facts really sink in.

TULELA: Before we get into the nitty gritty of salt formation, let's look at why this is an important process in chemistry. Time to get some insight from our Neural Networked Intelligent Computer Knowledge-bank – NNICK. Hi NNICK, can you tell us a little bit about salts please?

NNICK: Well, let's see. Ah, well a salt is any compound formed by the neutralisation of an acid by … [FUNKY BASS] Yes, a base. Obviously that's the wrong kind of bass, but it is slightly funkier than a hydroxide ion. Salts have many many many uses, for example in water treatment, medical applications and the food industry. How important is salt formation in those fields? Well, on a scale of 1 to 2, where 1 is "not at all important", and 2 is "so very very important, you wouldn't believe how incredibly important", I would say 2.

SUNAYANA: Thanks NNICK! In episode 1 of this series we looked at acids and alkalis and these are the key to salt formation. Have a listen to that if you need a quick recap.

TULELA: And we begin by taking an acid and reacting it with certain metals. Always good to have an example up your sleeve – so let's go with hydrochloric acid and magnesium. When we add these two together, we find that they react to form the salt magnesium chloride and hydrogen gas. We can confirm this by holding a burning splint near to the gas and if we hear a squeaky pop, [POP SOUND] that will indicate the presence of hydrogen.

SUNAYANA: Another example is zinc reacting with sulfuric acid. And in this case the product of the reaction will be the salt zinc sulfate and hydrogen gas.

TULELA: So in general, if a metal reacts with an acid then the products are a salt and hydrogen. Acid plus metal forms salt plus hydrogen.

SUNAYANA: If the acid is hydrochloric acid then the salt is a chloride. If the acid is sulfuric acid then the salt is a sulfate. And if the acid is nitric acid then the salt… Tulela?

TULELA: Nitrate.

SUNAYANA: OK. That's one way to form a salt. Another is when we neutralise an acid with an alkali or base. Let's start with alkalis.

TULELA: Whoa – hang on! Let's summarise the difference between alkalis and bases.

SUNAYANA: Sure. So all bases can neutralise acids but alkali is the term we use if the base is soluble – that is, it can dissolve in water. Bases that are insoluble are still called bases.

TULELA: So all alkalis are bases, but not all bases are alkalis. You may continue…

SUNAYANA: Thanks. So, when we neutralise an acid with an alkali we produce a salt and water. For example, sodium hydroxide NaOH is an example of an alkali.

TULELA: And when we react this with hydrochloric acid, we produce sodium chloride – that is the salt, and water. So acid plus alkali forms salt plus water.

SUNAYANA: And the name of the salt produced has two parts. The first part comes from the name of the metal in the metal hydroxide, and the second part comes from the acid used. Remember how the naming works!

TULELA: Hydrochloric acid produces chlorides, sulfuric acid produces sulfates and nitric acid produces nitrates.

SUNAYANA: Sounds reasonable to me.

TULELA: Perhaps dear podcast listening friend you'd like to have a go at this example. What is the name of the salt produced when we neutralise sulfuric acid with potassium hydroxide? You have five seconds before my dear amigo Sunayana gives the answer… in 3,2,1.

SUNAYANA: OK, so take the metal from the hydroxide and add that to the type of acid used and we get potassium sulfate – hope you also got that.

TULELA: Let's also have a look at some other bases – metal carbonates and metal oxides. In the case of oxides, the products are the same as for hydroxides – salt and water. For example copper oxide, which is insoluble so is simply a base, reacts with nitric acid to form copper nitrate and water. What about metal carbonates?

SUNAYANA: Acids plus metal carbonates react to form a salt, water and carbon dioxide. So, for example, hydrochloric acid plus copper carbonate form the salt copper chloride plus water plus carbon dioxide.

TULELA: Quick summary of all those reactions then. Acid plus metal form salt plus hydrogen.

SUNAYANA: Acid plus metal hydroxide form salt plus water.

TULELA: Acid plus metal oxide also form salt plus water.

SUNAYANA: And acid plus metal carbonate form salt plus water plus carbon dioxide.

TULELA: Whew!

SUNAYANA: One practical activity that you may be asked to describe is an experiment that forms crystals of a salt from acids and bases. Let's use as an example our base copper oxide and react it with sulfuric acid.

TULELA: Remember that as copper oxide is an insoluble base, it's a solid black powder. We slowly add this power to the acid to produce…

SUNAYANA: …acid plus metal oxide forms salt and water.

TULELA: Correct. So in this case the salt would be copper sulfate, which is soluble in water as a blue aqueous solution. Keep adding the copper oxide until there is no more reaction. We can tell this has happened because excess copper oxide, the black powder, will remain at the bottom. Now we need to filter off any remaining solids from the solution.

SUNAYANA: Funnel – filter paper – done. Collect the filtrate, which you'll remember is the solution that has passed through the filter paper – in this case the blue solution.

TULELA: And finally to get crystals of copper sulfate out of the solution, we use one of the separation processes we talked about in series one – crystallisation.

SUNAYANA: Which you may recall is to gently heat our solution in an evaporating dish until most of the water evaporates away, and then leave the rest to evaporate at room temperature. The slower the evaporation, the larger the beautifully blue copper sulfate crystals that are formed.

TULELA: Time for a quick salt-related quiz. Three questions, 5 seconds each. If you need more time, hit pause and do write the answer down dear podcast listening friend.

SUNAYANA: Question 1. What is formed when zinc metal reacts with sulfuric acid?

TULELA: Acid plus metal forms salt plus hydrogen. And the salt is zinc sulfate.

SUNAYANA: Question 2. Let's add calcium hydroxide to hydrochloric acid. What do we get?

TULELA: Acid plus metal hydroxide forms salt plus water. And the salt is calcium chloride.

SUNAYANA: And question 3. You add copper carbonate to nitric acid. What have you just formed?

TULELA: Acid plus metal carbonate forms salt, water and carbon dioxide. And the salt is copper nitrate.

SUNAYANA: Final summary, Tulela?

TULELA: Why not indeed.

SUNAYANA: Acids react with some metals to produce salt plus hydrogen.

TULELA: Acids react with metal hydroxides and metal oxides to produce salt plus water.

SUNAYANA: And acids react with metal carbonates to produce salt, water and carbon dioxide.

TULELA: To name the salt produced, take the name of the metal in the base and the type of acid used.

SUNAYANA: And to get crystals of a salt after a neutralisation reaction, filter and evaporate the resulting solution.

TULELA: Remember there's loads more chemistry on the Bitesize website.

SUNAYANA: You can listen on BBC Sounds for other episodes in this series as well as many more Bitesize podcasts.

TULELA: Thanks for listening! See ya!

SUNAYANA: Bye!