

## Scale and Scum

**Contents:** Questions based on an advertising leaflet concerning water softening.

**Time:** 2 periods.

**Intended use:** GCSE Chemistry and Integrated Science. Links with work on hardness of water.

**Aims:**

- To complement and revise prior work on hardness of water
- To develop awareness of the use of science in advertising
- To develop a critical attitude to scientific advertising claims.

**Requirements:** Students' worksheets No. 607. This includes copies of the pages from the advertising leaflet.

The questions in Part 1 are designed to test understanding of the topic of water hardness. Part 2 encourages students to look critically at some of the advertising claims.

### Notes on some of the questions

*Q.5* See note on 'Practical work' below.

*Q.6* See note on Q.8(b) below.

*Q.8*

(a) *Disadvantages of hard water:* Causes scale; wastes soap; causes scum; does not leave clothes and hair feeling soft after washing.

(b) *Advantages of hard water:* Many people prefer its stronger taste; provides calcium for teeth and bones; does not dissolve lead from pipes so quickly; there is some evidence that it may help prevent heart disease.

*Q.11* It would take just over fifteen years.

*Q.12* The percentage of fuel wasted due to scale will of course depend on the individual household, and in particular how well the hot water tank is insulated in the first place.

*Q.20* Scum consists mainly of insoluble calcium soaps, for example, calcium stearate. It may be unsightly, but there is no reason why it should itself be unhygienic, though it might conceivably trap bacteria in the basin or bath.

### Practical work

This unit could be usefully linked to practical work. In particular, students could carry out experiments to test the behaviour of soap and washing powder in hard and soft water, to investigate the claim that softened water saves waste. Experiments are described in Nuffield 13-16, *Making Molecules Work for Us*, in *Science at Work, Cosmetics*, and in a number of chemistry texts.

**Acknowledgements** We are grateful to ESTEC Ltd for permission to reproduce parts of their advertising leaflet.

## **SCALE AND SCUM**

Advertisers sometimes use scientific ideas to encourage people to buy their products. One of the benefits of studying science is that you can look at these advertisements to see if their science is accurate and fair.

You will be given copies of parts of an advertising leaflet used by the firm ESTEC to encourage people to buy water softeners. Read the leaflet, then answer the questions. Your teacher will tell you which questions to answer.

### **Part 1 The scientific background to hard water**

You may have to look at your work on hard and soft water to help you with these questions.

#### **Questions**

- 1 Look at the diagram on page 1 of the leaflet.
  - (a) Which of the rocks dissolves in the water to make it hard?
  - (b) Why does rain water dissolve this rock?
- 2 The leaflet describes two 'Terrors'— Scale (pages 2 and 3) and Scum (pages 4 and 5). What are scale and scum? Explain carefully how they are different.
- 3 The leaflet has a photograph of the inside of a hot water tank (page 2). Would you expect the inside of a *cold* water tank to get coated in the same way? Explain your answer.
- 4 (a) Why does soft water produce a better lather with soap than hard water?  
(b) Explain why 'hair looks and feels much better' when washed in soft water.
- 5 What experiments could you do to test the claim that softened water gives a better lather (page 5)?
- 6 When the water softener is installed it is possible to have a separate drinking tap delivering hard water. Why might this be desirable?
- 7 Scale is not the only cause of energy loss in a hot water system.
  - (a) What are the other causes of energy loss?
  - (b) How can these energy losses be reduced?
- 8 (a) List the disadvantages of hard water compared to soft water.  
(b) Are there any *advantages* of hard water?

## **Part 2 Looking at the advertising claims**

### *Page 2: Scale in your tank wastes energy*

- 9 How old do you think the tank in the photograph is? Is it:  
A 5 years      B 15 years      C 30 years  
D Impossible to tell?
- 10 Why do you think the age of the tank has not been given?

### *Page 2: Softened water saves energy*

- 11 According to the leaflet,  $\frac{1}{8}''$  ( $\frac{1}{8}$  of an inch) of scale on a hot water tank wastes £26 per year. How many years will it take to cover the cost of the water softener through this saving? Assume the softener costs £400 to buy.
- 12 Do you think the figures in the chart apply to all households?  
Explain your answer.

### *Page 3: Scale in your pipes*

- 13 How large do you think the pipe in the photograph is?
- 14 Why do you think the leaflet has not given the size of the pipe?

### *Page 3: Scale in your kettle*

- 15 Does your kettle at home look like the one on the left or the one on the right?
- 16 Do you think the two kettles are the same age?
- 17 Why is it important that the kettles are the same age?

### *Pages 4 and 5: Scum in your bathroom*

- 18 In what ways do the photographs try to show the advantages of softened water? (You should find 3 at least.)
- 19 The basin on page 4 is a darker colour than the one on page 5.  
Suggest a reason for this.
- 20 Scum in your basin 'is also rather unhygienic'. Is this a reasonable claim? Explain your answer.

## **General questions to discuss**

- Who do you think this pamphlet is aimed at? Why?
- Has it given a fair account of scale and scum? If not, what other points would you want to know?
- What questions would you ask the firm's representative if you were interested in buying a water softener?
- What changes, if any, would you make to the leaflet to try to encourage larger sales of water softeners?
- Would it be worthwhile sending the leaflet to all towns in Britain? Explain.
- What other types of firms might send leaflets to householders to encourage them to save energy?

# The Tale of Two TERRORS

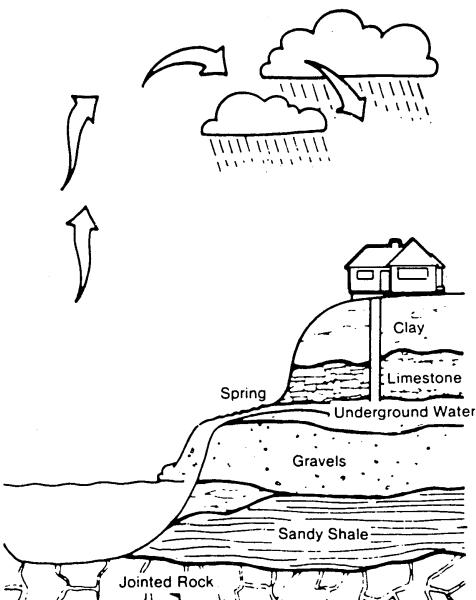


Dear Homeowner.

We apologise for approaching you in this manner but hope that you will spare us a few moments to glance through our brochure.

**IN THE BEGINNING** our water is pure and soft and gentle, but underground, deep down among the sedimentary rocks, lurk Scale and Scum. They dissolve in our water and are carried through the mains water pipes to our homes.

Once inside they cause all sorts of problems and needless expense. To find out more please read our tale.



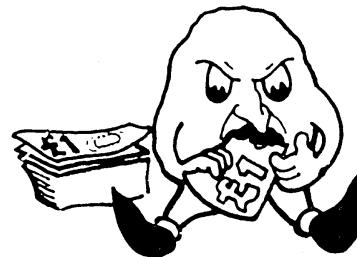
## SCALE IN YOUR TANK



### WASTES ENERGY

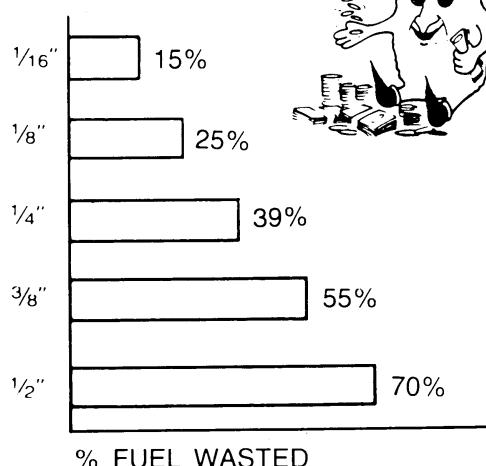
The picture shows what expensive things Scale does inside our hot water tanks. He covers the heat exchanger with a layer of limescale which makes it much less efficient so you burn more fuel to heat the water.

Eventually he clogs up the whole cylinder and it has to be replaced, but meanwhile he is making us spend more money on fuel bills to heat the water.



## SOFTENED WATER SAVES ENERGY

### THICKNESS OF SCALE



A family of 4 people spends about £2 a week to heat the hot water. If you have just a  $\frac{1}{8}$ " of scale you waste up to 25% of your fuel, which is 50p a week. That's £26 a year - wasted.

If you fit a water softener before it is too late, the softened water will slowly dissolve away all the Scale and leave your cylinder completely clear.

## **SCALE IN YOUR PIPES**

Scale gets in your pipes and slowly but surely blocks them up. Eventually you will have to replace them unless you do something now.

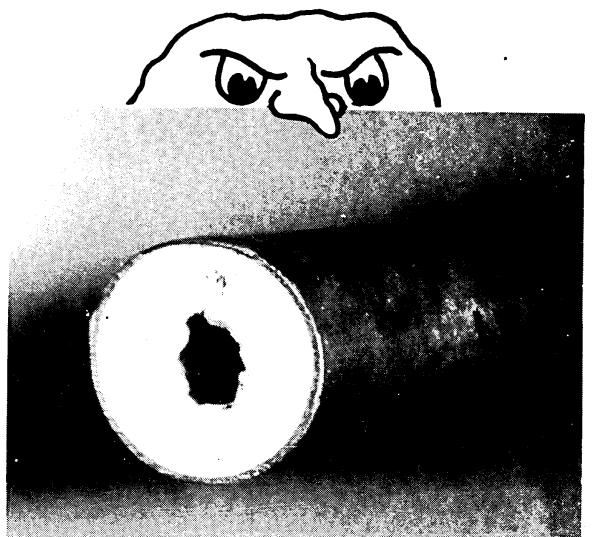
**If you fit a water softener before it is too late, the softened water will slowly dissolve away all the Scale and leave your pipes completely clear.**

## **SCALE IN YOUR KETTLE**

On the left you can see the kettle that boils hard water. It's scaled up and it's the same Scale that stains your teapot and coffee mugs.

Horrible, isn't he!

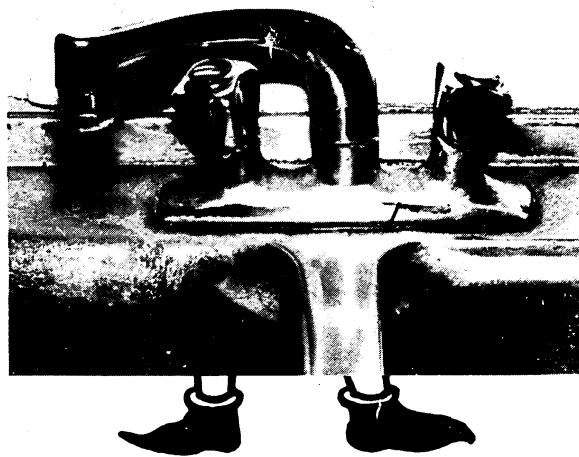
**If you fit a water softener he will completely disappear.**



## **SCALE ON YOUR TAPS**

Scale sticks to your taps and ruins the chrome. He also sticks all around your kitchen sink.

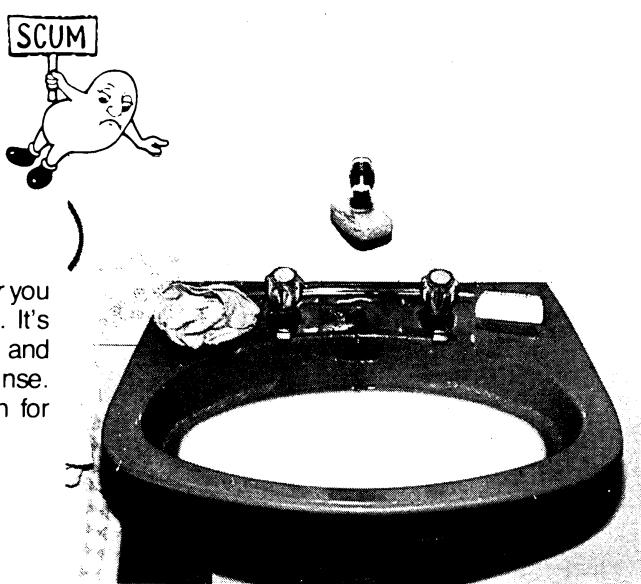
**When you have a softener fitted, you will never again have the chore of rubbing clean your stainless sink.**



## SCUM IN YOUR BATHROOM

### SCUM IN YOUR WATER

When you wash in hard water you always get a layer of Scum. It's rather nasty and unpleasant and sticks to the skin when you rinse. Many people suffer dry skin for this reason.



### SCUM IN YOUR BASIN

Every time you wash you have to clean the basin afterwards. It's hard work and never ending, especially when there are children around. It is also rather unhygienic.



### SCUM RINGS LEFT IN THE BATH

Taking a bath in hard water is not really the best way to get clean. You also have to scrub out the tub afterwards.





### **SOFTENED CLEAR WATER**

With softened water you get a lovely clear lather. It is much nicer to wash in and noticeably kinder to your skin. Your hair looks and feels much better too.



### **NO CLEANING UP TO DO**

After washing there is no scum left in the basin to clean up. That's right. No Scum to wipe away. **You only need clean the bathroom once a week.**



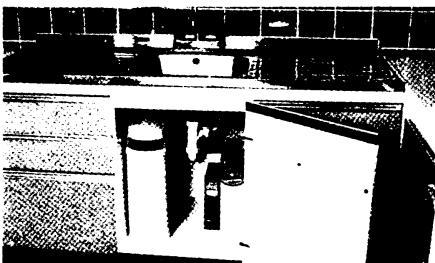
### **AND BUBBLES IN YOUR BATH**

Bubbles in your bath are guaranteed with softened water. You get the best wash ever and you feel much cleaner afterwards.



## A COMPLETE RANGE OF SOFTENERS... TO FIT EVERY HOME AND EVERY BUDGET

**Featuring the  
MINI KINETIC  
Britain's Best Selling  
water softener**



The KINETICO has two resin beds and a built-in water meter. This means that one softener is giving you water whilst the other is being cleaned. No electricity is used as the KINETICO uses the kinetic energy in the water pressure, hence its name.

- IT'S THE ONLY ONE THAT CAN...**
- Be tucked away, out of sight, under the kitchen sink and...
  - Cater for up to 10 people
  - Be easily adapted for various water hardness factors
  - Compensate automatically for demand variations
  - Operate without electricity
  - Does not allow hard water to contaminate working parts
  - Cleans itself with softened water
  - Use up to 50% less salt
  - Always provide soft water, without fiddly adjustments – no matter how much water you use
  - KINETICO –  
'THE ONLY ONE IN ITS CLASS'**

### Also available . . .

... the ULTRA-KINETIC  
for 11 people or more.  
Ideal for small Hotels, Restaurants,  
Offices, etc. and . . .

The Bruno range  
for small families and singles  
where water usage is  
fairly constant.  
(see back page)

All available from

**ESTEC**

**BRITAIN'S LARGEST  
WATER SOFTENER DEALER  
backed by**



All guarantees are subject to the terms and conditions printed on the guarantee document which do not prejudice your statutory rights.