

### TREVOR'S CORNER No 3

It is sometimes easier to answer a question if we reverse it and ask the opposite question. For example, about 700 BC King Hezekiah built a tunnel, now open to the public, to bring water from a spring just outside the walls of Jerusalem to point inside the walls. This enabled him to withstand a siege by the Assyrians. For many years archeologists were puzzled by the fact that the height of the tunnel varies between 1.5 and 5 m (5 and 15 feet). Why, they wondered, was the roof so high in places? Someone reversed the question and instead asked why the floor was so low. The answer then seemed obvious: when the tunnel was constructed the floor was too high in places for the water to flow and the floor had to be lowered. (From my book, *Dispelling Chemical Engineering Myths*, Taylor and Francis, Bristol, PA, 1996.)

In the May 2005 issue of *Chemical Engineering Progress*, p 48 Jack Hipple shows that similar methods can be used to find the answer to safety problems such as the cause of an incident. A product was shipped across the Atlantic in steel drums. The product was known to corrode steel but the rate of corrosion was so slow that the drums were not expected to leak. Unfortunately some did. Why? They had not been roughly treated or overfilled.

Reversing the question someone asked, "If we wanted the drums to leak, how could we make this happen?" The answer was, heat the drums so that the liquid in them expands. The investigators then looked for a source of heat and discovered that the heat output from the corrosion reaction was greater than the heat loss from the surface of the drums.

In another example, the level of liquid in a tank was measured by measuring the pressure required to bubble nitrogen through it. The nitrogen was then scrubbed to remove the vapor before it was vented to atmosphere. Unfortunately the scrubber was not as efficient as expected. The concentration of the absorbent in it was increased but some of the scrubbing liquid then set solid. Various ways of improving the scrubbing process were considered, all involving the addition of extra equipment. Then someone asked, "How could we make the leak bigger?"

The answer was “Remove the scrubber and just have a big hole, that is, an open vent”. The investigators then realized that the best way to prevent the leak was to use a different method of measuring the level in the tank and get rid of the nitrogen and the scrubber.

Jack Ripple suggest some other reverse questions such as, “How could we make sure that the company’s re-organization will be a disaster?”

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