

Translation of the Article “Dellen im Dach”, German Magazine “Der Spiegel”, Nr. 14, dated 29 March 2004, page 177 ff.

Dimples in the Roof

German researchers proved an effect which could revolutionize the design of ships, vehicles and aircrafts. Experiments in the wind tunnel showed: dimples in the surface of a body massively reduce the flow resistance.

The model looks like a crossing between a golf ball and an ICE high speed train. Sides and roof of the small train (scale 1:20) are covered with dimples, as if a strange sheet metal bubonic plaque had infected the train.

The object, however, is not a symbol of the starving Deutsche Bahn AG (German Railways), but is part of a scientific experiment. In a wind tunnel test at the German Centre for Aviation and Astronautics (DLR) in Cologne, the dimpled train passed recently a complex measuring.

The researchers cooled down the tunnel to minus 170°C the cold and thus denser air provided conditions closer to reality with this experiment. Then the scientists identified the flow reaction of the dimple train and compared in to a similar, but flat train.

Project leader Siegfried Loose, came to an unexpected result: the train with dimples has 16% less frictional resistance, depending on the speed.

With this astonishing result, the dimple method could be useful to revolutionize a wide range of industrial design. Never before had changes of the surface structure resulted in comparable improvement of aerodynamics. Trains automotives or aircrafts could be considerably more economic or faster when using the same amount of energy – only by using dimples in the body. This means a car could use 1 litre less petrol per 100 km when driving fast.

However, the measured result contradicts theorems of classical fluid mechanics, saying that unevenness increases the friction of a body, as this increases the whole

surface. "Theoretically, I cannot give any reason, why this had happened", says the physicist Loose, expert for industrial aerodynamics at the DLR for 12 years.

Less at a loss for an explanation is Nikolaus Vida, ophthalmologist and entrepreneur in Sigmaringen, a German town. He already has patent rights for the rather bizzare dimple principle called Tornado-Like-Technology (TLT). Vida claims, that tiny tornados are the reason for the alleged magic: the tornados are produced in the dimples and would then jump from dimple to dimple, thus producing a kind of ball bearing effect between the vehicle and the outer air. But this is not proven so far. This is the boldest theory since the discovery of the so-called shark skin, which also reduced the flow resistance with its fine roughness and is fairly understood by physicists today. Airplanes and yacht hulls have already been covered with it. The effects, however, are not as huge as the effects of the peculiar dimples. For some years now, Vida runs a type of talent agency, called "Inventors Network" for outrageous scientists, which puts great hope in the industrial marketing of TLT, now. The tornado technology is based on calculations of two physicists from the Soviet Union, who discovered the principle already in the 1980s, when supplying surfaces of fuel elements and turbine vanes with dimples for improved cooling. Through that, Gennadij Kiknadse and Iwan Gachechiladse discovered an unexpected side-effect: not only the temperature dropped, when using dimpled rods, but also the flow resistance of the cooling agent pumped along, decreased. Since then, both researchers deal with the calculative and experimental concerns of this phenomenon.

After the decline of the Soviet Empire, they indirectly got to the talent tutor Vida, where they act as intellectual keepers of TLT, now. Nobody had a comparable knowledge, claim Vida.

And this is enormously important. Someone, who is randomly thinning sheet plate with dimples, possibly worsens the flow reaction. Vida: "you can also incredibly brake down with dimples." With the knowledge of the Russian physicists, on the other hand, the right size and placing can be determined for every area of application and every speed. TLT could be applied not only for vehicles and aircrafts, but also in plant construction and shipbuilding. Vida already proved a similar effect of dimpled plates in the water canal of the shipbuilding research institute in Hamburg as he did with the DLR measuring: the flow resistance reduces immensely with even 17%.

Projecting this figures as energy saving potential for all means of transport all over the world, provides a scenario that makes one dizzy. The ophthalmologist looks euphorically into the future. TLT were “an invention of the wheel for air and water”. It seems that the world novelty is similar to the already known golf ball. The rubber ball also spangled with dimples flies considerably further than a ball with a flat surface. But this can be explained with the laws of fluid mechanics and has obviously to do with the ball shape. Balls itself are aerodynamically very convenient, because there are strong turbulences in their lee. Dimples in the golf ball make sure, that braking turbulences are reduced.

This effect is much less significant with long railway trains. In the wind tunnel test from Cologne, the ends of the train were even excluded from measuring. Therefore, there has to be another explanation for the considerable improvement of the flow reaction on the dimpled model.

Tests that transfer the experiences of the golf ball to other areas exist already. In 1982, the arms producer Schuberth, Braunschweig brought forward a helmet called “Speed” for motorcyclists, with a surface similar to a golf ball. It showed little air resistance and was “advantageous for turning the head” said, senior developer Oliver Schimpf.

In 1999, the second improved model with additional transverse ribs came on the market. It is still on offer today, but is not much accepted. “Helmets with flat surface”, says Schimpf, “were always sold much better as the ones with the extravagant surface, although they are inferior.”

The tornado prophet Vida, too, might get problems with marketing the dimple technique. Aesthetic reservations are to be expected. Car buyers rarely are convinced by ecological motivations, as seen from previous experiences. Chances of selling a saving car that looks as if it was damaged by hail appear to be low. And how do they dimple the glass surfaces? With scrap slides? One of the first who are intensively looking into TLT is the Siemens Group. Especially for power plant building, like turbine vanes and for railway constructors the technique offers tempting perspectives.

An aerodynamic specialist of the Siemens railway section already sneaked around the dimpled ICE Model, eager to learn. It is not only the aerodynamics of the dimple train that interested the engineer. TLT could also help with another problem, which is worrying the German railway more at the moment than energy consumption.

With the increasing speed the ICE achieves 300 km/h in regular traffic the high speed train is also more vulnerable to side winds. The problem is unsolved until today. The German Railway has put up wind protection walls on especially dangerous places and speed limits. For years, the engineers search for an elegant solution.

The dimple technique could provide them. During the wind tunnel tests, Loose turned the train model also with up to 40 degrees lateral in the flow. The first optical analysis showed considerably weaker turbulences on the side of the wind of the dimpled train model.

In general, the DLR man says, the train was however “not a parade example of the application of the dimple technique”. Different to the tested models there is a pantograph and numerous aggregates on the roof of the real ICE, which can hardly be put somewhere else for technical reasons. “The whole roof garden”, says Loose, “is mixing up everything”.

Translated by Inventors Network GmbH, Germany.

In case of doubt as to the proper interpretation of this report German text shall prevail.