

# Penguin Down Feathers

## Biomimetic Principle

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University of Reading



Penguin Feather have a 3-D velcro-type structure which makes them an excellent insulator: Penguin feathers consist of many small hooks – similar to Velcro. The hooks mean that the feathers cannot slide relative to each other. When they are compressed by the pressure of the water, they are bent and then jump back into shape like springs when the penguin leaves the water. When the penguin dives the air is pressed out of the feathers, the coat collapses and the penguin becomes thin and streamlined. When the penguin leaves the water again, the coat must inflate immediately; otherwise a wet penguin would be unable to survive at temperatures that are typically below minus 20 degrees Celsius.

Down feathers have long been prized as a highly efficient natural insulation material, although due to their water-retentive properties and cohesion when wet they perform less effectively when wet. Natural preen oils give some protection against moisture to untreated down, but commercially available down has been cleaned of its natural oils to remove the odour. The down feather is a particularly good insulator because of its structure: a shaft of circular cross section (barb) and perpendicular fibres (barbules) Synthetic alternatives are often used as their efficiency is not reduced when wet, but they provide a lower insulation value per unit weight because they do not have the natural feathers' barbules.

### Papers:

Dawson, C., Vincent, J. F. V., Jeronimidis, G., Rice, G. & Forshaw, P. (1999). Heat transfer through penguin feathers. *Journal of Theoretical Biology* 199(3): 291-5.

Bonser, R., Dawson, C., (2000) The mechanical properties of down feathers from gentoo penguins *J. Zool., Lond.* (2000) 251, 545-547

Bonser, R., Dawson, C., (1999) The structural properties of down feathers and mimicking natural insulation materials. *J. Materials Science Letters* 18 (1999) 1769 - 1770

### Websites:

<http://www.rdg.ac.uk/biomim/personal/richard/keratin.htm>

## Applications

Variable thickness active thermal insulation structure:

Research at the University of Reading to investigate whether the effect could be mimicked to create better clothing for extreme conditions was sponsored by the Ministry of Defence

## Current Commercial Development

Not yet developed