



## Green Wheels

Karbon Kinetics Ltd.

The world's lightest production electric two-wheeler produced by British company Karbon Kinetics Ltd. (KKL) was developed partly using rapid injection moulding provided by Protomold®, part of Telford-based Proto Labs®.

It appears that the inexorable rise of the electric vehicle has well and truly begun and that whether it has two, three or four wheels, personal transport that is silent, swift and clean is set to change the way we travel and commute.

Gocycle is an electric two-wheeler that has been designed as a means of urban transport with young city-based professionals and their families in mind. It combines portability, style and on-demand electric power to offer the rider the health benefits of cycling and, at the push of a button, a no-effort, emission free run-around. Gocycle's high-powered electric motor is discreetly hidden in the cycle's front hub allowing the rider to quickly reach 15mph and travel for up to 20 miles on a single charge, depending on how much he or she decides to pedal.

Mr. Richard Thorpe, Gocycle designer and founder of KKL, explains the business rationale behind the creation of the vehicle:

“Urban commuters around the world are becoming increasingly frustrated by poor transport infrastructure,” he says, “as well as city government actions to reduce traffic congestion and the ever-increasing costs associated with travel.”

Although the traditional bicycle has enjoyed a renaissance in recent years, focus-group research clearly shows that pedal power alone does not meet the needs of all commuters for several reasons, including: the effort required to travel long distances and the discomfort and inconvenience of working up a sweat on the way to the office. Gocycle addresses these issues and also provides consumers with a vehicle that is stylish and beautifully made.

Before founding KKL, Mr. Thorpe worked directly and indirectly as a design engineer for some of the world's most prestigious motor sport companies, including McLaren Cars, Bentley, Audi, Ferrari and Mercedes. He founded KKL in 2002 with the aim of developing and commercialising light electric

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vehicles — from small city cars to electric motorcycles — starting with Gocycle, the lightest production electric bicycle currently available and the first injection-moulded magnesium alloy bicycle in history. Given his professional experience, it's no surprise that Mr. Thorpe began development of the Gocycle with very clearly defined high specification manufacturing criteria, which also encompassed the selection and appointment of technology and service suppliers.



“We chose the best manufacturing options available from around the world,” he says. “Proto Labs offered a totally unique service to our product designers that made our development process much faster. You just submit your 3D CAD model to the ProtoQuote® automated online quoting system and you receive pricing, options

and advice for improved mouldability within hours.”

Gocycle's frame is made using magnesium; however, main mechanical parts, such as the rear suspension unit are made using a specially formulated nylon filled with long glass-fibres. The expertise to injection-mould this lightweight, strong material (which consists of 60 per cent glass), was provided by Protomold.

According to Managing Director Mr. John Tumelty, the company's senior engineers had never previously worked with a material incorporating such high glass content. For this reason, they were uncertain how well the material would flow during the injection moulding process.

“Warp problems are generally more prevalent when using glass-filled resins,” says Mr. Tumelty, “and the difficulties tend to escalate in proportion to the amount of glass content.”

Working closely with Karbon Kinetics, Protomold scrutinised the CAD geometry of all the components that required moulding. The information collected was entered into Protomold's in-house flow analysis software Protoflow®, so that a visual prognosis of the injection moulding process could be established.

The company's engineering team then tested the different location points where the plastic enters the mould cavity (known as gates) and analysed the various pressure and temperature conditions required to achieve successful component moulding. At the end of the project Protomold had developed 47 individual injection-moulding tools, which were subsequently used to manufacture the required parts.

A very important element of Gocycle's design criteria was durability, so Protomold developed

tools to eliminate potential weak spots that could occur if the material flow during the injection moulding process wasn't reliably uniform. The look and the perceived build-quality of Gocycle were another two items high on the list of design criteria. Most of Gocycle's parts have a consistent, shiny black finish, which Protomold engineers achieved by determining the precise velocity at which to inject the material into the cavity.



“On parts where aesthetics are very important, it is easy to end up with deviations in colour or texture as a consequence of abrupt material acceleration,” says Mr. Tumelty. “If you get the process wrong when moulding material with very high glass content, the fibres can rise to the component surface and you end up looking at black plastic through glass fibre. It's a strange silvering effect that's very unattractive.”

Because the burgeoning market for electric bicycles is so hotly contested, anything less than a perfect finish would compromise the look and feel of Gocycle.

“Our research shows that the electric two-wheeler market is expected to enjoy double-digit growth in the next decade,” says Richard Thorpe. “Protomold provided our product designers with an easy, fast, responsive and cost-effective way to obtain plastic injection moulded prototypes and parts. This meant we could compete with big-name cycle manufacturers with substantially bigger budgets. At KKL, we used this to take advantage of the market opportunity and build a better, city-specific mobility solution that is stylish, cost-effective and fun.”