eatec ENGINEERING CONSULTANTS

ACHIEVING EXCELLENCE IN ENGINEERING

Rubber Property Predictor

Special Points of Interest:

- Stress-strain behaviour of rubber is sensitive to composition and processing, and difficult to predict.
- Software tool developed to enable 'virtual' testing of possible rubber compounds.
- Time and cost of achieving the required characteristics is greatly reduced.

The Problem

The stress-strain behaviour of rubber is sensitive to variations in chemical composition and process parameters such as cure time. This coupled with non-linear behaviour, makes it difficult to predict the mechanical performance of different formulations.

Typically manufacturers of rubber components have to produce and test several samples under shear and tensile loads before identifying the formulation which gives the mechanical performance required. Clearly this is a time consuming and costly process.

Eatec undertook a project to develop a method by which the stress-strain relationship could be predicted for a user specified chemical composition and process conditions.

The Approach

A software program was developed based on a neural network, which is capable of taking the proposed composition of a rubber and predicting its stress-strain behaviour under shear and tension.

In effect, it performs a 'virtual' test, and hence the amount of physical testing required is greatly reduced. A neural network requires data which it uses to learn the relationships between input and output parameters.

These relationships are typically non-linear. The data must cover the input ranges of interest. In this project it was two chemical composition parameters and one process parameter.

Rubber samples were manufactured and tested, and the results used to train the neural network to predict the stress-strain curves.

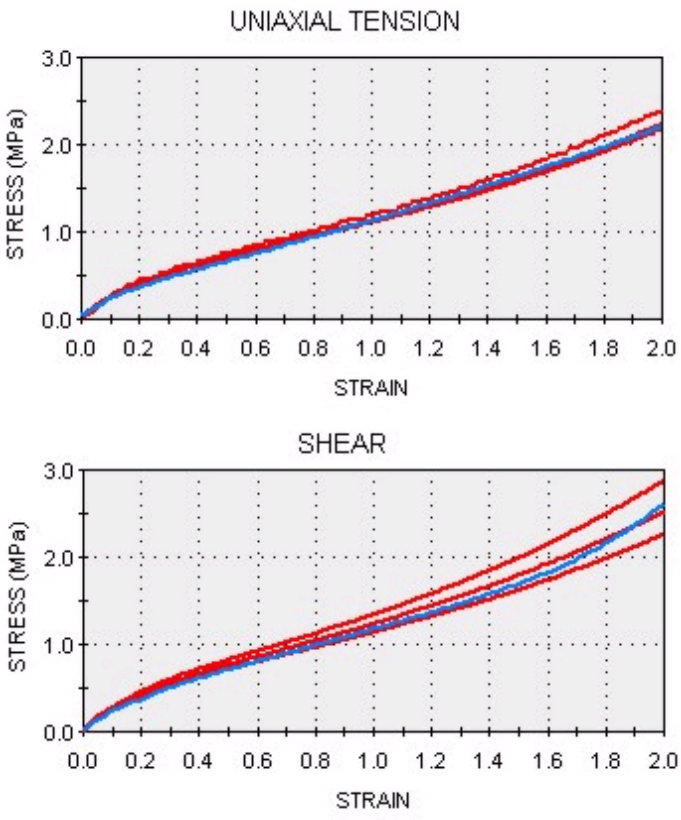
The Results

After training, the neural network was able to predict accurately the stress strain relationships across the ranges of composition and process parameters.

The network was embedded in a software program which provides a user friendly interface.

The user selects the values of the input parameters and the network is run to display the predicted stress-strain curve for the formulation.

If required, the user can then select a material model and strain range, and output the appropriate coefficients for use in subsequent finite element modelling of the component, or other forms of analysis.



Benefits to the Client

By using a software program to predict the properties of a rubber on the basis of the composition and processing, it is possible to evaluate a number of options in a cost and time efficient manner.

Greater optimisation of the rubber is possible using this technique than would be practicable through physical testing.

As a 'virtual' test concept is used, in which the stress-strain curves are generated, it is possible to output the coefficients for any new material model which may be introduced.

Tel: + 44 (0)1454 332240
Fax: + 44 (0)1454 332249
www.eatec.co.uk
ref CS003

eatec
ENGINEERING CONSULTANTS

3 Armstrong Court
Armstrong Way
Yate
Bristol
BS37 5NG