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McMaster University uses ADMET eXpert system to examine the mechanical properties of bones

The Department of Mechanical Engineering at McMaster University of Hamilton, Ontario recently began conducting biomechanical research. The projects, under the direction of Assistant Professor Greg Wohl, PhD, studies the effects of mechanical loading on bone through compression and flexure testing. The University had not conducted this type of research and, although well-equipped for mechanical testing, some new equipment was required. Wohl needed a materials testing device commonly called a Universal Testing Machine (UTM) to precisely stress bone specimens for analysis. He selected an ADMET eXpert 5601 UTM with related electronics and load cells. The new UTM replaced a Mechanical Engineering Department Instron machine that would require a new load cell and an electrical update. In researching his options, Wohl discovered that the complete ADMET system could be purchased for a fraction more than a new Instron load cell. The lab has been using the eXpert system for about six months with excellent results. Wohl is now considering a second ADMET machine to perform pull-out tests on screws used in orthopaedic applications.

McMaster University Assistant Professor Greg Wohl is researching how biological tissues, specifically bone, adapt to mechanical loading and what the mechanical properties are after being stressed.

Research looks at the structural and material properties of bone and includes the effects of diet, nutraceuticals, osteoporosis and aging.

Explained Wohl, a biomedical engineer, “Bone is not an inert structure. It actually is one of the most metabolically dynamic musculoskeletal tissues in our body.”

The research has tremendous application to human health. He continued, “Diseases like osteoporosis and osteoarthritis are not terminal illnesses but they affect a huge number of people.

“Musculoskeletal disorders carry heavy costs in terms of the pain and suffering caused by injuries and resulting hospital stays, but they also have real costs in terms of ongoing pain, loss of work time and productivity, and mobility issues.

“So, we’re looking at preventative measures for bone-related disorders and/or therapies for treatment of bone-related disorders. We know that mechanical loading triggers new bone formation. However, what causes the bone formation to occur and how to maintain bone mass differ and are not as immediately apparent. So, we’re starting to look at gene expression, and what the cells ‘see’ when they’re loaded.”

The tests, conducted on mouse and rat bones, seek to determine the mechanotransduction response

SOLUTION OVERVIEW

Industry: Bone research

ADMET Product: eXpert 5601, eP Digital Controller and load cell

Customer: McMaster University, Mechanical Engineering Department

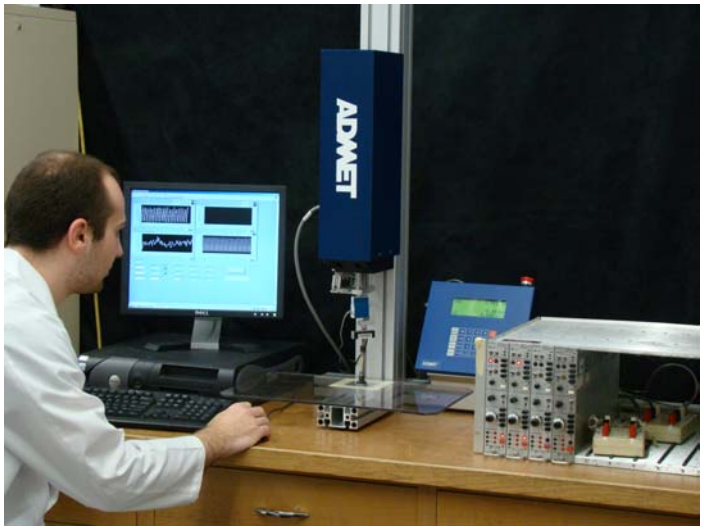
Application: Testing bone specimens

of the cellular materials in order to identify the molecular signals for new bone formation.

Updating equipment

The research required a universal testing machine to perform bend and cyclical flexure tests. The tests had to be tightly monitored and controlled in order to stress specimens to pre-determined levels. The lab had an older Instron that required a new load cell, as well as likely electrical upgrades.

Wohl was familiar with testing machines since he had used them in his doctoral and post-doctoral work. He contacted Instron for a replacement load cell. The cost for a new cell was high, so he began searching on the Web for used units. In doing so, he found an ADMET ad on LabX and, after contacting the company, discovered that he could purchase a new eXpert 5601 tabletop system with controller and the required load cell for US$6,000 – just US$1,000 more than a new Instron load cell.



Setting test parameters

Wohl's first task with the eXpert system was to develop a typical profile for bone failure so that he and his graduate assistant could determine the forces required to induce failure of the test specimens.

Using the data, he and his graduate assistant were able to develop profiles under which they could conduct bend and cyclic flexure tests to pre-determined percentages of failure and record deformation over hundreds or thousands of cycles.

In order to monitor the tests in real time, Wohl added a second load cell, as well as a National Instruments data acquisition card and LabVIEW Laboratory Information Management Software (LIMS) on a networked personal computer.

"Now, we're recording real-time information and, based on the accumulation of displacement as indicated by LabVIEW, we know when to stop the test. We may stop at 50 percent of damage accumulation or 30 percent, so we have close control and know precisely the level of damage when we examine the adapted specimens," said Wohl.

The new testing system is delivering results that support his research. Wohl plans to discuss some of his findings at the Ontario Biomechanics Conference and present to the Canadian Orthopaedic Research Society. Wohl also hopes to publish findings in journals, such as the *Journal of Orthopaedic Research* or *Journal of Biomechanics*.

Wohl sees additional applications for ADMET systems. A new project will require that he conduct pull-out tests of screws for spinal reconstruction and Orthopaedic applications.

Anticipating his needs, he said, "We'll test the mechanical integrity of the screws and how they are applied. We'll require a different actuator and will need to apply much greater loads."

For more information:

For more information about ADMET products or services, please call us at 800-667-3220 or 781-769-0850, email sales@admet.com or visit our Web site at http://www.admet.com.

For additional information on McMaster University, visit http://www.mcmaster.ca.