Testing of Accu-Screwdrivers in Li-Ion Technology

Measured Value Acquisition and Measured Value Processing

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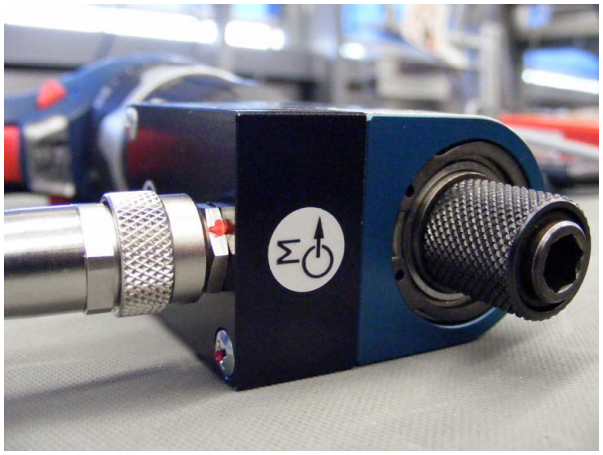
Analysis of Problems and Concept

In the past years the utilization of lithium-ion accumulators was increased significantly in the field of cordless screwdrivers. The many advantages (no memory-effect, full power until the end, little self-discharge, more performance at lower weight and volume, etc.) assure that in the meanwhile every reputable manufacturer offers compact screwdrivers with Li-Ion-Technology.

Target of the project is to determine the differences between the so far used conventional accumulator technology (Ni-Cd or Ni-MH) and the new Li-Ion-Technology and to make a declaration regarding the “better” accumulators.

Three new compact screwdrivers with Li-Ion-Accumulators, a cordless screwdriver with Ni-MH-Accumulator and a Ni-Cd Accumulator are available as test objects. A torque sensor of Lorenz Messtechnik GmbH (DR-2153 / 20 N.m) and a digital storage oscilloscope “MEphisto Scope UM202” of Meilhaus Electronic are used for the measured value acquisition. The measured value processing occurs through Agilent VEE 8.5.

The comparison between the accumulator screwdrivers shall be carried out in step with actual practice conditions in order to receive a representative result for the usage site (craft) of the screwdrivers.



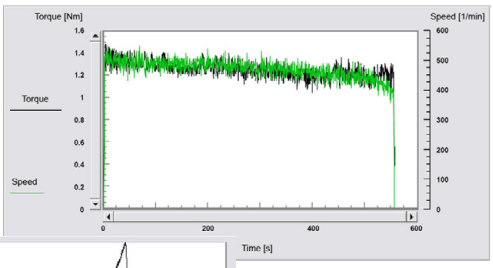
Picture 1: Accumulator Screwdriver with Torque Sensor

Layout and Specification

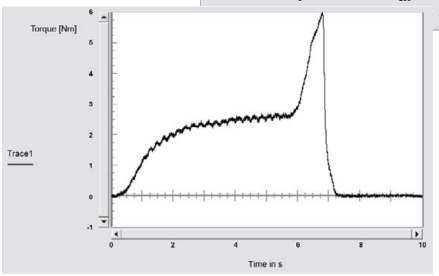
The comparison of the screwdrivers and/or the accumulator technologies behind it is based on a sustained loading in which fastening of wooden screws in a piece of pine wood gets simulated. This means that the accumulator screwdrivers do not fasten “real” screws in “real” wood, but they are loaded with a constant torque which is equal to the fastening of a real screw (picture 3).

At full accumulator, each accumulator screwdriver should countersink “simulated” screws until the power perceptible decreases or until the electronics shut-off the accumulator screwdriver. Picture 2 shows the long-term recording of speed and torque of a simulated 4x40mm screw (constant load of 1,2 N.m) of a Li-Ion-Accumulator screwdriver to be tested.

In order to compare the results, the required torque and fastening time of different screws was traced for each screwdriver (picture 3).



Picture 2:
Sustained loading with a simulated 4X40mm screw



Picture 3:
Torque characteristic of a 5X60mm screw (pine wood)

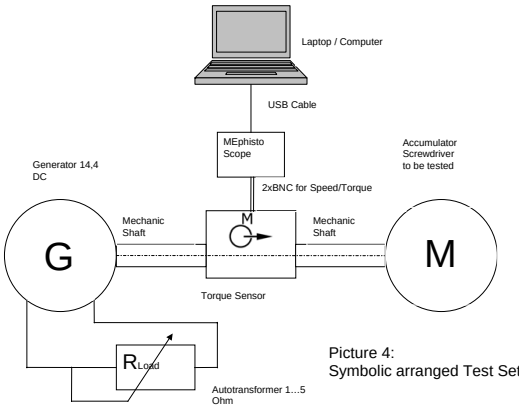
Technical Realization

A torque sensor of Lorenz Messtechnik GmbH gets clamped in the drill chuck of the accumulator screwdriver to be tested. The mechanical connections begin and end with a standard hexagonal socket (picture 1). The electric connections are led to 2 BNC-sockets through an 8-wire connection and connected to MEphisto Scope of Meilhaus Electronic.

A generator is connected on the opposite side of the sensor. The generated power is converted to heat in a changeable resistance (picture 4). Through the variability of load, different torques corresponding to different screw lengths and screw diameters can be simulated.

The sensor supplies the current torque as tension between 0V and 10V and the speed of the screwdriver through 360 square pulses/rev. The electric signals are detected by a MEphisto Scope of Meilhaus Electronic and are sent to a PC through the USB-Interface.

The measured values are processed in a Agilent-VEE-Program. The torque is calculated from the tension and the speed and/or the driven angle is calculated from the square pulse string. The current values are displayed and stored in a *.csv-file every 100ms. After ending the measurement, the results are represented in two diagrams (picture 5).



Picture 4:
Symbolic arranged Test Setup

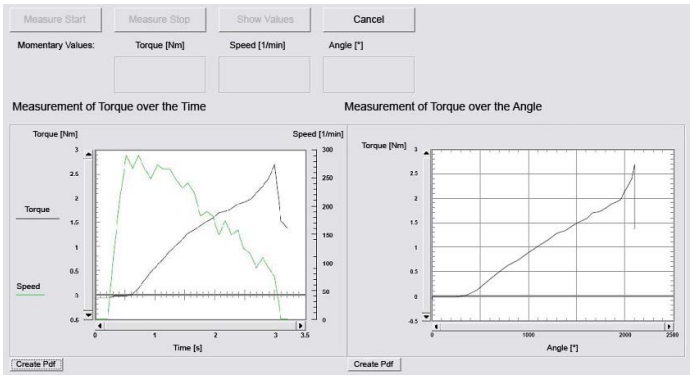
Results

The Lithium-Ion-Technology has gained much importance in the field of accumulator screwdrivers. In comparison to conventional accumulator screwdrivers of good quality, the expectations were clearly excelled.

All of the Lithium-Accumulator screwdrivers are very compact and by this light and very easy to use. A great advantage is the constant power until flat.

Conventional and low-price accumulator screwdrivers lose perceptibly accumulator power after a short usage time.

The constructed measurement program is not only suitable for durability tests, it can also record sequences which require a short runtime.
This is the case for example at the measurement of “soft” torque or of single screwing processes of accumulator screwdrivers.



Picture 5: Operating Interface VEE-Program