Built-in QC Checks and Balances in Chem Lab

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Introduction

Mistakes made in the chemistry lab could have disastrous effects. Mistakes range from shipping a failed heat to customer to producing thousand of tons of steel that doesn't meet the requirements and adversely impacts valuable production time. Hence, it was only natural to build in logic into QMOS application that would disposition heats and alert the users when an element or a set of elements are out of spec. QMOS chem. Lab screen has been developed, mainly to allow the users to evaluate the chemistry test results of the heat against the specs of the grade or the heat. The functionalities of this screen have vastly grown since. In this document we'll cover conceptually what QMOS Chem. Lab screen is able to achieve and the added value to the business process can be better understood.

Interfaces

Over the years, interfaces that feed chemistry lab screen in QMOS have been improved to not only receive test results from ARL machines – spectrometer and Leco machines- but also calculate Jominy or CE, on the fly, as need. Recently, for some mills, new logic has been developed to calculate expected tensile strength based on chemistry.

Furthermore, the interface analyzes the data on the fly and determines whether the test result for the element is within spec in its intended work center.

Chemistry Lab – Heat Tab

Chemistry laboratory screen drives of the heats melted and tapped in QMOS. Essentially Chem lab screen goes hand in hand with the melt shop module and upon creation of heats in QMOS, the heats become visible on the chem. Lab screen.

The status of each heat is reflected on the screen which is driven from the location of each melt heat in QMOS.

Screen shot of the heat tab is provided on the following page. Heats are listed in the order of their respective tap dates with the most recent heat appearing on top.

The user has the ability to search for specific melt heats or search by grade, work order, tap date or even look up heats that are on hold for any reason.

What frequently occurs in melt shops, if an element is out of spec by a minute amount, the users may want to have the ability to force pass the heat and remove the hold flag based on their discretion. The customer may be willing to accept the heat even if it is out of range by a tiny amount.

That's a decision made at the mill level by the QC personnel. Field level security has been designed to allow or disallow users to force pass heats that fail chemistry or jominy tests.

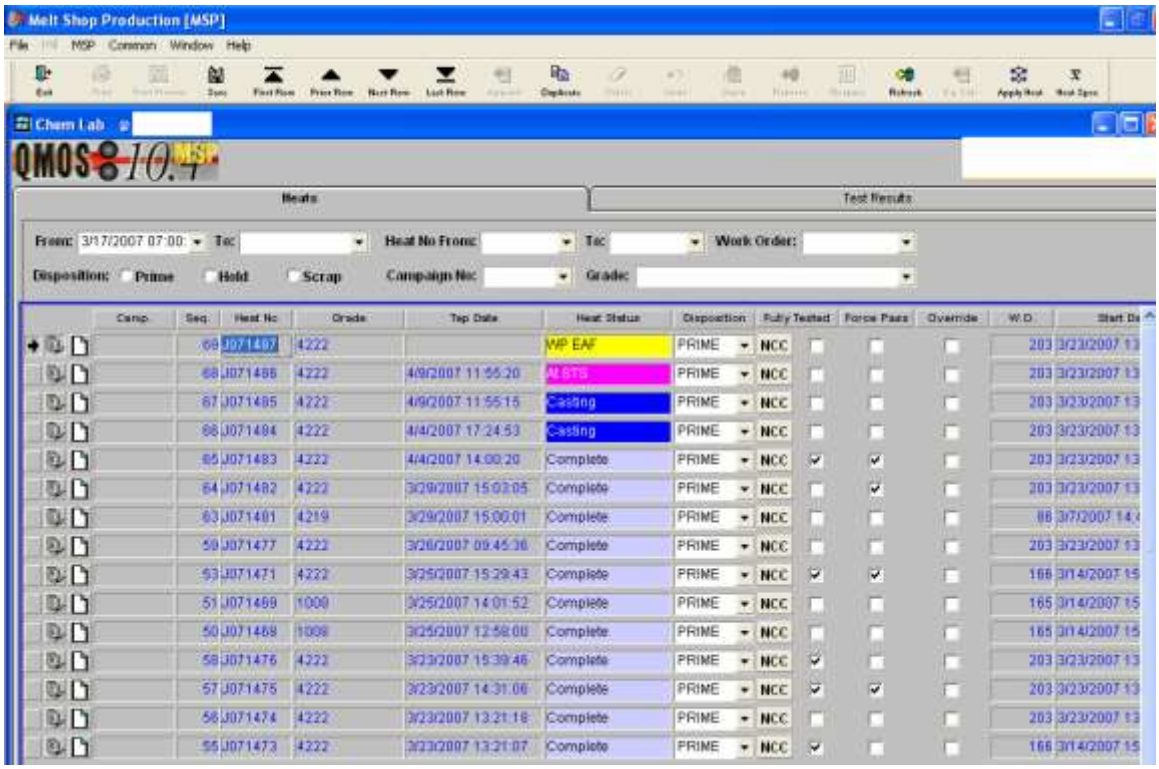

Figure 1: Layout of the QMOS Chem Lab Screen – Heat Tab

Chem Lab – Test Results

Upon receiving chemistries, QMOS evaluates test results of the given sample and compares it against the specs of the work center. If the sample test results fail to meet the specs at a critical work center, the heat goes on hold.

A work center is deemed critical where the chemistry test results that are outside the specs need to put the heat on hold, which is typically the caster.

There is visual indication of what element has failed on the test display as shown in the following page. Elements that pass their respective specifications are highlighted in green and elements that are outside of the range are highlighted in red.

If an active sample has failed chemistry test results at the caster work center, the heat is automatically placed on hold. Most mills set their mins and maxes according to specifications stipulated by ASTM standards and they rest assured that heats that don't meet the specs are on hold until further review and don't get rolled or shipped to their intended customer.

The user also has the ability to set internal specs and evaluate the performance of the melt shop based on their internal specs. For example, in order to optimize alloy consumption the mill could set their own internal specs for Carbon and Manganese to be between 04 and .44 and 1.19 and 1.29 respectively, as demonstrated below.

These specs however are not to disposition the heat since they are for the mill's internal purposes rather than a hard stop. In the example below, the mill may choose another element like CE to be the determining factor which dispositions the heat.

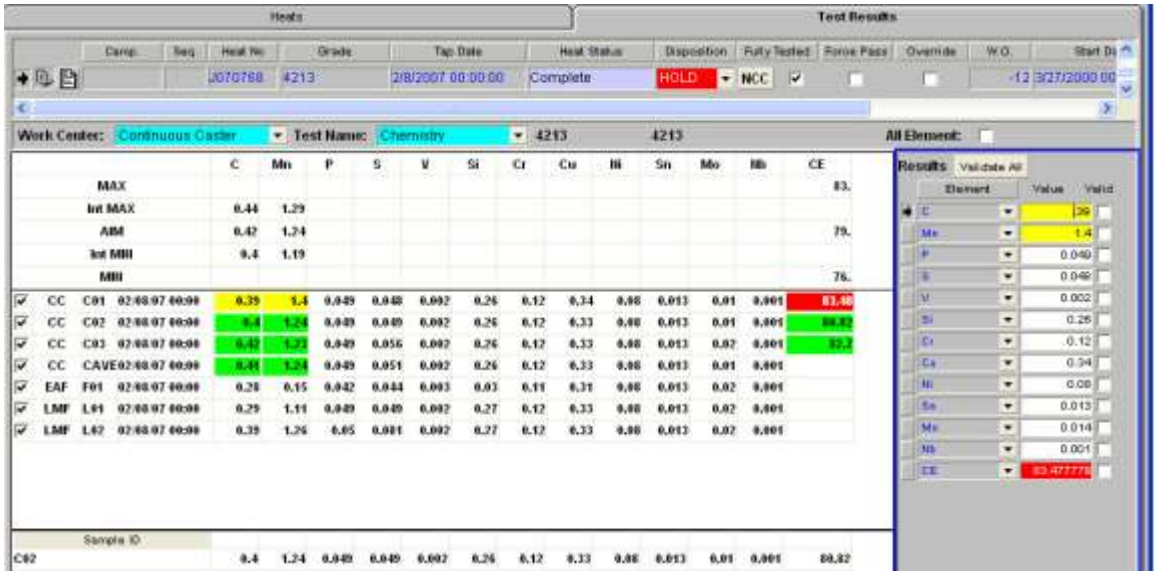

Figure 2: QMOS Chem Lab Screen – Test Results

In the example above, C and Mn are out of their internal specs for the selected melt heat. There is no absolute min or max for those elements and QMOS highlights the test results for those elements in yellow, indicating that they're outside of their internal range but its simply a warning. The element that does place the heat on hold is CE which is highlighted in red. Since the CE value is outside the absolute max value defined in the specification, the melt heat is automatically placed on hold.

The QC personnel can subsequently decide to force pass the melt heat based on their discretion or divert it to a different grade. QMOS provides tools for ease of identification of these issues and equips the QC manager with all the tools necessary to quickly address missed heats as they are melted.

The newest functionality that has been designed in QMOS is the ability to calculate specs on the fly based on the first sample received. Algorithm can be modified based on

customer requirements. Currently, depending on the chromium content of the heat, aims for Carbon, Manganese and a few other elements are set as internal specs. The melt shop is subsequently evaluated on their success in meeting those aims.

This feature allows for optimizing consumption of alloys in the melt shop. There are reports driven from this functionality that show the QC manager how each shift performed. These reports break down performance by shift, crew, melt grades and serve as important tools for managers.