HATCH IAS envoy

DECEMBER 2009

A Word from the Director

Welcome to the December edition of Envoy for 2009. It is a time when minds are turning to end of year holidays and new year celebrations, reflecting upon the year's achievements, what we have learnt, and what the future may bring.

To all the members of the Hatch IAS team I would like to thank you for your efforts this year where you have maintained the quality of the services delivered to our clients throughout the various changes and challenges introduced by integrating into Hatch.

In this edition of Envoy we review the augmented coating mass control offering now available as a result of the merger, and examine the impact of improved modelling on our hot mill technology that is being deployed at the new 7 stand hot finishing mill for Shougang. Finally we remind you all about the next IRTC where we look forward to providing an excellent opportunity to learn about rolling in a city renowned for such educational activities...Oxford!

INSIDE

A New Coating Mass Control System:

Hatch has been building world class pot equipment for strip processing lines for more than a decade. Hatch IAS has been the leading provider of coating control systems for years. The logical next step is to take the best technology from each system and combine them into a new one.

The new system will be capable of applying all the common metallic coatings like zinc, zincalume, aluminium and galvanneal.

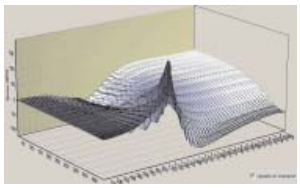
The basic design includes three major components: Level 2 (adaptive model based references generation, interfaces to the coating gauge and line automation, reporting and HMI); Level 1 (closed loop actuator controls); and hardware (tool free, low maintenance, self calibrating pot equipment).

The system will, like its predecessors, achieve market leading coating performance via position and pressure control or simply pressure control.

The system will be offered in such a way that customers can pick and choose from the components that make most sense for them. This means the full range of possible solutions from brownfield upgrades/retrofits to full greenfield supply can be accommodated.

The system will be available in 2010.

Impact of Improved Models for Mill Setup:



Hatch IAS has striven since its inception to develop and apply the most effective mathematical models of the flat metals industry. This obsession has been motivated by a desire to better understand, and thereby better control, the production process. In this effort we stand on the shoulders of giants such as Orowan, and Tozawa, and we utilise the latest computational tools and techniques to extend the reach of the industry's understanding.

An instructive example for examining the impact of such efforts can be found in the control of the mill flatness and profile of hot rolled strip. This challenging application has several objectives. Firstly to avoid damaging cobbles, we must maintain acceptable flatness between each of the hot mill stands (there may typically be up to seven). At the same time we desire to produce material with the minimum deviation from the target specified strip thickness profile at the mill exit. To achieve this we need to control the flatness and profile actuators available on each of the rolling mill stands.

This challenge is well suited to the application of modelling due to the need to have an accurate setup from the very head-end of the piece in the absence of key process measurements. At the present time there is no proven technology for measuring the inter-stand strip flatness. This rules out the use of simple feedback control techniques to avoid strip cobbles. Further, the final exit thickness profile, which is measured, arises from the cumulative and interactive effect of the profile exiting each stand. These intermediate profiles are not measured in today's rolling mills.

To meet this challenge, a mill typically deploys a combination of experienced mill operators and an automated mill setup. Both the operator and mill setup utilise internal models (mental experience model for the operator; adapted mathematical model for the automation) to estimate what the actuator settings need to be to achieve the objectives for the next piece. In this situation the operator has significantly more feedback information available than the automation due to an ability to observe inter-stand flatness. At best, the automation obtains an indirect measure of these important parameters by observing the action of the operator. So until a reliable inter-stand flatness measurement is available, it is fair to note that the operator will continue to play a significant role in the overall control of flatness and profile.

However the development of flatness and profile through a tandem mill is a complex phenomenon. This fact puts distinct limits on the ability of even the most experienced operators to accurately anticipate required actuator settings during times of significant process disturbance such as product changes and roll changes. It is in these circumstances that accurate process models can introduce significant improvements in the process performance.

Product Transition Performance

In the following example we examine the impact of the introduction of the latest generation of profile and flatness models on the outcomes of a product transition.

An important aspect in understanding the differences between various models is to compare the simplifying assumptions that were used to construct the model. Such assumptions are inherent in all mathematical models and represent a necessary step to allow a solution to the problem within the time available.

The previous generation of models used for profile and flatness control, typically ignored the transverse flow of material in the strip, and assumed that even reduction was consistent with even elongation (flat strip) emerging from the roll bite. Further it was typically assumed that this occurred with a flat pressure profile across the width of the strip in the roll bite. Finally in many systems a flat pressure profile was assumed even for stands where the profile was being changed. This last gross assumption was then partially corrected through the application of an inheritance model whereby the exit profile from a stand was a blend of the incoming profile to the stand and the loaded rollgap profile calculated assuming a flat pressure profile. These assumptions in effect removed the calculation of the stress and strain state of the strip, including the rollgap pressure profile from the model.

These were known to be significant assumptions but they were necessary at the time to allow the problem to be drastically simplified to the point that it could be solved in the online setup environment.

With improvements in computer power and an immense amount of focused development effort, Hatch IAS has been able to do away with these simplifying assumptions in its new generation of profile and flatness setup model. This new generation model incorporates a high speed solution for a 2 dimensional finite element representation of the strip thus enabling online calculation of the rollgap pressure profile as well as the stress and strain state of the strip. This strip model allows complex effects such as transverse material flow and inter-stand creep to be accounted for.

So what is the actual impact of these changes on the prediction of actuator references, inter-stand flatness and profile accuracy?

The figures below show the differences in a transition between the two products given in Table 1.

	$W \times H \times h \times \theta_F$	Material Type
Product A	1450mm x 35mm x 2.5mm x 875°c	Low Carbon Steel
Product B	1200mm x 35mm x 2.5mm x 875°c	Low Carbon Steel

Table 1 Differences in a Transition Between Two Products

Fig. 1 Roll Bending Settings

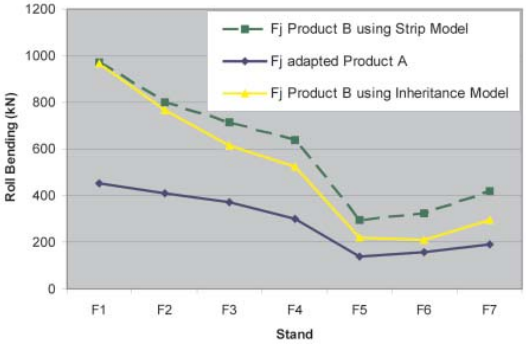


Fig. 2 Thickness Profile Trajectories

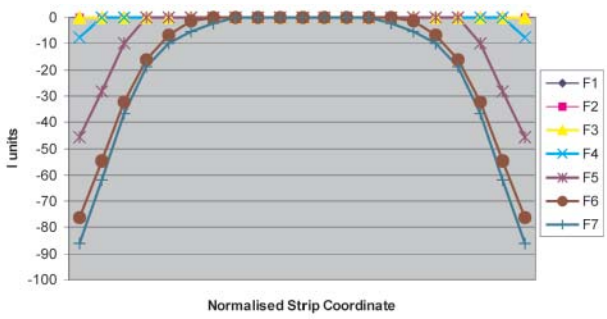


Fig. 3 Flatness Post Inheritance Model Transition

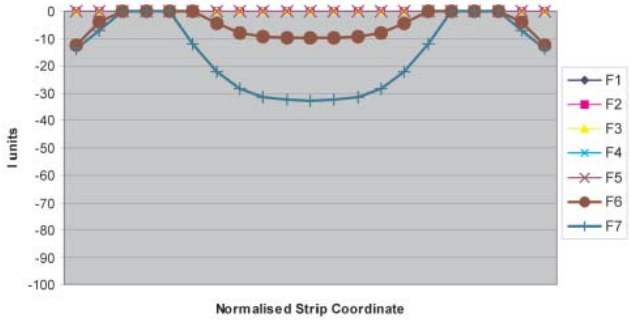


Fig. 4 Flatness Post Strip Model Transition

Prior to the transition, product A had been rolling for sufficient bars for the mill operator trims and adapted model to ensure the mill was producing the target exit profile with no inter-stand flatness problems. On switching to product B the following charts show the change in actuator settings and resulting inter-stand flatness and exit profile using either a well tuned inheritance model system or the strip model system.

The main differences which emerge arise from the assumption of even reduction equating to flat strip in the inheritance model system. This assumption introduces problems in the estimation of buckle limits, hence the flatness problems shown in Fig. 3, and represents an un-modelled change in the actual profile that emerges from each stand, which can be seen in the profile error shown in Fig. 1.

After the transition has occurred, the combined action of the operator in trimming the stand and adaption brings the results back into alignment over several bars. So the impacts of the improved model is better performance during process disturbances, and less reliance on operator skill in the efficient production of quality product. The latter is of increasing importance as many facilities are increasingly working with less experienced operators and/or difficult new product mixes.

IRTC35:

"THE WORLD'S LEADING COURSE FOR THE FLAT ROLLING PROCESS"

The New Year is fast approaching and what better time to get organised and start planning your training for 2010!

Our next International Rolling Technology Course will be held in the UK. The last time the course was held in the UK was back in 1996. The course is now heading into its 21st successful year and continues to attract a dynamic mix of delegates from all over the world, so we invite you to join us in 2010.

Oxford University

COURSE LOCATION AND VENUE

IRTC35 will be held from Sunday 18th April to Friday 23rd April 2010 in the historic city of Oxford, UK. Oxford is located approximately one hour by car from central London.

The course will take place at the leading 'Macdonald Randolph Hotel'. This beautiful traditional hotel displays elegance and grandeur and provides the highest level of comfort and service in a traditional environment. The hotel is situated close to restaurants, theatres and shops and offers a vast array of entertainment.

Tutorial

ABOUT THE COURSE

Through a carefully structured five and a half days of lectures, tutorials and discussion group sessions, delegates are exposed to over 120 years of practical and theoretical experience in the modelling, operation and automation of flat metal rolling mills.

Lecture

Originally developed to fill a niche in the training of rolling mill technical staff, IRTC has been used to fast track new engineers along the steep learning curve of flat metal rolling as well as develop the careers of more experienced employees in the metals industry.

However, the course objective is to enable delegates with all levels of experience to solve problems specific to their area of interest by providing a firm understanding of the major concepts and characteristics of flat rolling and to provide them with the opportunity to interact with others in similar situations.

Highlights of the IRTC course are the computer based tutorial sessions and the interactive discussion sessions which stimulate the delegates into building new ideas and concepts. Hence, it is not surprising to find that when surveyed delegates rank these as the most valuable and beneficial aspects of the IRTC experience.

SPECIAL OFFERS

EARLY BIRD discount fee is available to delegates who pay before 14th February 2010.

I would also like to remind you that previous delegates can return to the course at a special discounted half price rate.

REGISTRATION AND COURSE DETAILS

To register for the course and obtain further details we encourage interested delegates to visit our website at **www.indauto.com/irtc**

All enquiries should be directed to **irtc@hatch.com.au**

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