Robotized repair welding of forging dies  
- Next generation welding cells -

Preface

Forging industry is under the combined heavy pressure of many different factors:

- an healthy increase in demand for ever more performing parts
- diminished demand visibility
- raw materials supply uncertainties
- raw materials price volatility
- lack of skilled and reliable labor / welders
- high turn-over of technical operators with consequent leaks of precious company know-how

Overall these combined factors create a set of conditions that push the industry leaders towards investing decisions in assets, people and working capital that are very difficult.

In a previous paper Neweld SA has already explained the advantages that repair welding with robotized welding cells can offer to the increasingly stressed supply chains and forging operations.

It is the purpose of this new paper to introduce the audience to a number of new features and developments that have been deployed in the last year:

- full process control by means of integrated data collection systems (Industry 4.0)
- improved welding program software simulation environment – post-processor
- robotized overlay welding in open die forging application

Introduction

Forging dies are quite often the make-it-or-break-it factor in an highly competitive market:

- short lived dies inherently create an increased number of production lines’ schedule disruptions – more production halts – more opportunities for mistakes during dies changing
- unpredictability in dies performance create expensive bull-whip like shocks throughout the whole supply chain only controlled by means of stock, over production and huge spare parts pools standing on the shelves
- larger and larger pools of dies are needed to fulfill the ever more differentiated demand for forged parts - this is obviously an important economic force pushing return on assets in the wrong direction

In our previous paper we have already presented the reasons why weld repairing by means of robotized welding cells is by far the best solution to face the above mentioned issues and gain a sustainable competitive advantage.
Let me quickly benchmark the available options for the sake of completeness:

- repair welding vs disposal of worn out dies, replaced by new ones
  - repair welding allows for the application of different materials to different areas of the dies thus tackling different type of stress with the best performing material
  - repair welding only uses the minimal amount of precious high performing alloys for a given set of forging conditions
  - repair welding can build impressions variants on an existing die without the cost of going green field – new block, new machining ....
  - repair welding can be recursively applied to the same impression with only minimal stress being accumulated in the carrier block of less expensive materials
  - repair welded dies have quite often a life span well above 150% of the original die

- repair welding vs progressive slicing of a worn out impression layer
  - slicing is not applicable to forging machines with limited flexibility on the thickness of the dies
  - when the thickness problem is patched with the welding of height equalizing plates of material underneath the dies block, thermal and mechanical discontinuities are introduced in the block itself – shorter dies lives are the least of the problem while defective production lots and fractured dies parts flying around the workshop are the most important ones
  - recursive and repeated slicing are not feasible and are major factors in increased unpredictability in operations
  - slicing is not a functional recovery option when cracks are present in the impression

- robotized repair welding vs manual repair welding
  - robots can weld in very hot and unforgiving conditions (big blocks radiating large amount of heat)
  - robots are not sensitive to welding fumes nor radiations – increasing attention to HSE
  - robotized procedures are inherently repeatable
  - robotized procedures are easy to reproduce – almost independent to the operators skills and experience – this is a key advantage when skilled man-power is not readily available
  - robotized procedures are more efficient – one operator can easily control 3 to 4 robots at the same time
robotized procedures are a company asset – robot don’t run away with precious company knowledge

robots are reliable – when proper maintenance programs are in place!

robots don’t have Mondays nor Fridays

• robotized repair welding vs semi-automatic repair welding

  • semi-automatic welding requires the constant presence of an operator – it is less efficient than off-line programmed robotic routines

  • semi-automatic welding needs a human controller that introduces higher variance in terms of quality and productivity

  • semi-automatic is still heavily relying on operator’s experience and know-how – a rare and difficult to control factor

  • semi-automatic welding routine are known to over deposit material thus creating waste and longer machining time

Recent developments

During the last year Neweld SA (now fully integrated into DGWeld srl) has sold and increasing number of robotic welding cells for repair-welding and with a great number of those sales going to happy returning customers – those who had one wanting for more.

With the increase of sales to companies with multiple production site we have been challenged to make the solution scalable over distance and through slightly different installation.
Thanks to our partners we managed to introduce features in the post-processor software that made straightforward to clone installations and exchange programs to and from cells located in different continents. Needless to say this is giving a new dimension to the speed of return on the investment in robotic welding cells.

Other important progresses have been made to the post-processing of CAM programs on dies with radial symmetry - tubular shape and very narrow extrusion bores where the robotic manipulation of the welding torch has been traditionally very difficult. This application has a number of features in common with traditional cladding / hardfacing application for O&G pipes but it has the outstanding advantage of being deployed on a fully anthropomorphic robot unit with extended functionality and unsurpassed versatility.
By leveraging the Industry 4.0 support from the European authorities we managed to integrate single robotic welding cells data to MES softwares and have a real time picture of the progress ongoing in terms of repair welding jobs while at the same time introducing a level of traceability compliant with the most demanding quality standards.

Other progresses that we have achieved are stretching to the field of welding on spheroidal cast iron and multi layered overlay welding of heavy duty open dies forging tools.

DGWeld holds a patent on this technology that was only made possible by leveraging the most advanced welding programs developed by our partners with our know-how on robot programming.