Rocco the 'Start-up King' launches yet **another** business

With eight businesses across a spectrum from PM through industrial leasing to disaster and emergency planning already to his name, Rocco Petrilli has started a ninth new venture in abrasive machining. He talked to Joe Capus...

One of the benefits of attending international PM conferences and exhibitions is the opportunity to meet and discuss new developments with leading characters from the industry. At the recent MPIF PowderMet 2009 conference in Las Vegas, the writer had the chance to meet with Rocco Petrilli (Figure 1), veteran of no less than nine start-up businesses. He was eager to talk about his brand new venture in the forming and finishing of complex PM parts with the aid of super-abrasive machining that will facilitate the improvement of manufacturing costs as well as expand the scope of part designs.

Figure 1. Rocco Petrilli, President/CEO of Super Abrasive Machining Innovations LLC, is eager to demonstrate the advantages of SAM for the PM parts industry.

Super Abrasive Machining Innovations LLC (SAMII) is a new start-up company providing super-abrasive machining contract services to the PM parts fabrication industry. It was established by its president/CEO, Rocco Petrilli, in January 2009 and is located in Ridgway, Pennsylvania, with a new 7500 square foot building housing two super-abrasive machining (SAM) units that are already up and running.

Petrilli reported sufficient interest from the automotive PM parts sector to justify a third more powerful machine that has already been ordered. The facility also houses additional PM part finishing equipment for deburring, etc. Petrilli has partnered with Steven G Meyer, himself a 25-year veteran of the PM industry and of four of Petrilli's start-ups/expansions. Meyer will serve as SAMII's General Manager, Figure 2.

Petrilli's interest in SAM stems from his experience in the late 1990s with timing chain sprocket manufacture. Automotive timing chain devices were becoming more complex with new engine developments and the emergence of VVTs. This resulted in sprockets becoming more intricate, with some sprocket systems carrying as many as five chains. Sprockets were also being produced in the as-hardened condition by the introduction of sinter-hardening. Finishing by hard turning was and remains a significant challenge. One solution to the problem of forming such complex sprockets by the PM route was to convert the teeth finishing operation to SAM. SAM has been described as "grinding at the speed of machining". It has a special attraction for PM part production in that it can be used to form design features such as hubs and slots that can't be made by conventional

Figure 2. PM industry veteran Steven G. Meyer has joined SAMII as General Manager.

Figure 3. SAM enables cost-effective forming of two hubs on a 65mm × 18mm PM sprocket. (After Petrilli and Elie)

punch and die compaction. It is also capable of stock removal at a high rate. However, this is not a technology that is familiar for the PM parts industry. Nor do many fabricators have the expensive equipment required.

In 2006, Petrilli linked up with equipment-maker Max-Tek LLC, of Newington, CT, with a plan to offer properly-engineered SAM systems to PM and other near net shape forming industry fabricators as a turn-key solution. However, with capital availability being limited by the substantial downturn in the parts market, this did not take off as expected. Petrilli subsequently decided to go into sub-contracting, making SAM available on an out-sourcing basis, with an investment aided by the Northwest Savings Bank and the North Central Pennsylvania Regional Planning and Development Corporation.

Petrilli added that education was critical in persuading industry users of the merits of SAM in enhancing the net-shape forming attraction of PM fabrication. The MPIF PowderMet 2009 Conference in Las Vegas provided an excellent opportunity to extol the virtues and benefits of super-abrasive machining. In his presentation of a paper jointly authored with Ed Elie of Max-Tek LLC, Petrilli reviewed the rationale for setting up SAM as a sub-contracting service, adding that it was particularly relevant at the present time in the face of market and credit restraints in manufacturing industry. The offering of SAM on a sub-contracting basis thus became a logical extension of Petrilli's existing and continuing turnkey services.

Super-abrasive machining has long been used in the aerospace and defence manufacturing industries, especially with difficult materials, but so far only a handful of PM components fabricators have embraced the technology. This has been partly due to the large capital expense (eg Typically $500 000 for a complete system, including efficient coolant filtration), but mostly due to the lack of education in the benefits and cost advantages of SAM. Petrilli's new venture will also be able to take up the educational challenge, especially as the facility is based in the heartland of the US PM industry. As Petrilli explained, SAM is unique in component finishing operations. It offers the precision of grinding combined with the speed and cost associated with single-point machining. In the PM component sector, interest has been spurred by the growth in sinter-hardening and the challenge this has created in finish-machining of both as-sintered and hardened steel parts.

The primary process advantage of SAM in "feature-creation" through substantial stock removal at economic rates means that cost justification in its application can extend well past the simple cost comparison between SAM and alternative machining/grinding operations. Petrilli gave an example of a 65mm × 18 mm PM sprocket, Figure 3, where SAM was used to form two hubs. Floor-to-floor cut time was 22 seconds, with cost superior to that of grinding or single-point turning. But Petrilli pointed out that further analysis would show additional processing cost savings as follows:

- 25% increase in compaction rate because of simpler compacted part
- 30% decrease in mean press set-up time due to less complex tool layout
- 35% lower tool build cost associated with the above
- 20% reduction in tool maintenance costs due to stronger, more robust solid punch design.

He went on to give some details of the SAM process and equipment, noting that SAM was not intended to replace either machining or grinding, but rather to act as a truly hybrid process that complemented the others. Two types of SAM wheel are currently employed: vitreous-bonded CBN (cubic boron nitride) and electroplated bonded CBN. Most often, SAM employs an electroplated wheel incorporating a single layer of CBN super-abrasive particles. CBN is second only in hardness to diamond, but without the tendency of diamond grinding media to react chemically with ferrous stock. The SAM wheel runs at higher than normal speeds, up to 30 000 surface feet/minute, to achieve high rates of stock removal and does not require dressing. Wheel life is exceptional, with about 40 000 parts completed before replacement is necessary.

Wheels are machined before plating to enable accurate profiles to be cut with uniform removal of stock. Cutting fluid pressure and flow are highly critical in the success of SAM, the desired rates achieved through design of nozzles that can number as many as 14, with the object of precise delivery of the coolant at high pressure so that it can also function as a lubricant. The machines themselves are equipped with CNC capabilities. The shells of these particular (Max-Tek) machines are not made out of metal but a polymer material, the design and application of which has proved very effective in dampening vibrations. The lower the vibrations, the more successful is the removal of stock and the accuracy of finished dimensions.

Results are very cost-effective when correctly applied. Petrilli showed numerous examples to illuminate this point. He sees SAM expanding the range of application for PM and listed a number of niche applications/situations where SAM would be advantageous if properly applied. These included: the combination of multiple steps into a single operation (e.g. stock removal and finishing); PM gears and sprockets with interrupted cuts; combining lower-cost single-action PM pressing with SAM to produce features typically formed by more expensive compaction equipment; and any operation where the lower pressures and forces of SAM allow large amounts of stock removal without potential damage to the PM workpiece.