

FROM SKY TO EARTH

STOCKPILE SURVEYS AT LAFARGEHOLCIM TANZANIA WERE TYPICALLY AN EXPENSIVE, SLOW AND INFREQUENT ACTIVITY. PAUL MANDATTA DISCUSSES HOW A CHANGE IN APPROACH AND THE INTRODUCTION OF UAVS TRANSFORMED OPERATIONS

Measuring and managing material stockpiles across large plant and quarry sites can be a complex task, with hazardous conditions and a diverse range of materials to analyse. However, such activities are vital to keep track of raw material consumption and ensure effective inventory management.

Situated in Mbeya, Tanzania, close to the border of northern Malawi, Burundi and the DRC, LafargeHolcim Tanzania operates a cement plant and a limestone quarry, servicing customers inside and outside the country. Historically, LafargeHolcim Tanzania's stockpile surveys were an infrequent activity, taking place, on average, every three months using theodolites and total stations. External surveyors were contracted to conduct these terrestrial surveys, setting ground control points (GCPs) and taking checkpoint measurements across the site. This contributed to the time spent in the field, with each survey costing approximately US\$5,000 and taking, on

average, two days to complete – a significant investment of time and money.

To address these logistical concerns, the team, led by plant manager Hossam Elzohery, began exploring alternative ways to accurately manage and measure the plant's inventory. Having learned of the successful introduction of UAVs at LafargeHolcim's Nigerian plant, we saw an opportunity to improve operational efficiencies by replacing their terrestrial mapping techniques with an aerial approach.

A team of three people – including me – took part in a two-day workshop with a senseFly trainer, which involved an introduction to the technology, expert coaching on how to fly the UAVs, and insights into how best to process data. Following this workshop and discussions with UAV operators at other sites in the organisation, the team determined that UAVs would offer the most efficient, cost-effective solution, resulting in the purchase of two senseFly eBee's in early 2017. The eBee



LafargeHolcim Tanzania's cement plant produces up to 800,000 tonnes per year

came with senseFly's eMotion 3 flight planning and data management system, as well as Pix4Dmapper photogrammetry software, offering the team an integrated, easy-to-use solution.

End-to-end solution

Capable of covering up to 12km² in a single flight, the eBee was loaded with the senseFly SODA camera, a 20 MP true-colour RGB





senseFly's experts provide full training and ongoing technical support to local operators on how to use the UAV software



LafargeHolcim Tanzania operates two senseFly eBee drones, which it introduced to improve operational efficiencies

payload, with images geotagged by the eBee's in-built GPS. Ensuring that flights were conducted safely and in line with local regulations was crucial. Prior to each mission, flight timings were communicated to Songwe airport, which is less than 5km from the plant and quarry, to ensure all operations were safe and compliant. The mapping process itself was simple and thanks to the UAV's ease-of-use, fewer personnel were required, meaning that I could be the sole operator. Flights were planned using eMotion software, with the ground resolution and required image overlap specified in advance, and then conducted over the plant at 120m for a period of around 30 minutes per mission.

Upon completion of each flight, Pix4Dmapper photogrammetric software was used to process the images – typically around 320 per flight – and produce high-resolution digital surface models and point clouds from which the team defined stockpile volumes. A specific formula was then applied to each stockpile volume, which was relevant to the material in question, to calculate its total tonnage. Relative accuracy was achieved

– typically one to three times the ground sampling distance – which for such stockpile volume calculations was more than sufficient, and enabled the team to capture reliable, actionable data, without the need for time-intensive GCPs.

Redefining ways of working

In total, the whole process, from planning to flight to image processing, was completed in less than a day, representing a 50% reduction in survey times compared to terrestrial approaches. Using a UAV also helped to improve staff safety, as previously surveyors had to climb the stockpiles when using terrestrial equipment – a task that now can be conducted with ease and at a safe distance, without compromising accuracy. In fact, the UAV provided around 100 times higher density data than the previous ground-based approach, therefore greatly improving the accuracy of data.

Crucially, the efficiency of the approach has enabled the team to survey its stockpiles more frequently, further improving its inventory management. Previously conducted once-a-quarter, measurements now take place every

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month, with the UAV used to manage up to 15 stockpiles of materials, including limestone, gypsum and clay, enabling the team to accurately calculate the volume of raw materials consumed during the previous month. The cost savings from the UAVs mean they effectively payed for themselves in just four months.

In addition, the UAV's data has proven invaluable when planning new stockpile locations or repositioning materials. In such circumstances, the team can fly the site with the eBee in approximately 30 minutes, using the point cloud data collected to map the free areas of the plant and determine the most suitable relocation zone.

Quarries and beyond

In addition to activities on the plant site, the senseFly eBee has also been used to help optimise blast activities – a key part of LafargeHolcim's operations. By surveying the quarry with the UAV, the team has been able to create detailed contour maps that it overlays

with the quarry's block model, to provide in-depth insights into the site and produce a precise mining plan to more easily identify the grade of limestone for mixing.

Beyond the site itself, the UAV has also contributed to the organisation's CSR agenda, as the team has used the eBee to identify

use the senseFly eBee for stockpile volume calculations on its plant and quarry sites and is even planning to extend its uses to new applications. For instance, during the dry season, the team will use the UAV solution to produce a full digital terrain model of the quarry, to check exactly where rocks are

THE UAV HAS BEEN REVOLUTIONARY, ENABLING PLANT STOCKPILE SURVEYS TO BE COMPLETED TWICE AS QUICKLY AS BEFORE

various farming activities around the plant and provide unused parcels of land to local farmers. This has enabled LafargeHolcim to more easily define the boundaries of the different farming plots and maintain a close dialogue with the communities around its sites.

Future uses

Following the successful adoption of UAVs, the team at LafargeHolcim will continue to

exposed and identify the different types of rock on-site. With end-to-end UAV solutions adaptable for different missions, the technology offers a future-proofed, highly accurate mapping solution for complex mining and quarry applications.

Paul Mandatta is quarry geologist at LafargeHolcim Tanzania (www.lafargeholcim.com)

Each eBee flight is conducted at 120m for around 30 minutes

