**WASTE MANAGEMENT**

The Other Side of Manufacturing

Regardless of where in the realm of optical manufacturing you are, waste is an inevitable consequence. How it’s managed is critical to the success of any process. Fortunately, there are equipment solutions with the latest chilling, filtering, and processing technologies, to streamline the handling and application of slurry, water, coolants, and resulting waste. These unique systems address waste management from the standpoint of profitability and compliance. A well-engineered filtration system will payback its investment in consumable savings, reduced downtime, output quality, higher yield, lower waste removal costs, and environmental compliance. Systems can manage waste for smaller operations or be modularized for expansion. Relying on the principle of sedimentation and centrifugal force, centriﬁges and separators are capable of eliminating even the finest particles of silicate and plastic. Very popular in optical and precision optics, these systems maintain cleaner coolant, longer tool life, and higher flow rates. See TURBO-HKS below. Filtration systems via membrane technology also eliminate harmful contaminants. Highly selective, sorbent ﬁbers of varying micron sizes, capture hazardous and nonhazardous impurities, resulting in a liquid stream suitable for normal discharge or recycling. The additional enhancement of chilling equipment will maintain constant, cool temperature, eliminate unwanted ﬂuctuations, and dramatically reduce defects. While compliant ﬁltration systems will ready waste streams for disposal, removal is the next phase and usually, at an added expense. Solid waste, like the plastic chip-by-product of C39, can be reduced into compact bricks, either at the point of origin or integrated into larger central systems with TURBO-HKS compactor technology. Evaporation, the thermodynamic process converting water to vapor, is perfect for de-watering waste streams with high solids concentration. A closed system, the MegaVap from UPI, reduces disposal volume, its associated cost, and maintains local EPA compliance with permissible discharge levels.

**HIGH PERFORMANCE CENTRIFUGE SYSTEMS With Built-In Coolant Processing**

Recently, TURBO-HKS introduced the T06 and T10. Complementary with oil and water-based coolants, both systems can separate even the ﬁnest swarf from process fluids. Each maintains a smaller footprint that includes a built-in tank, supply pump and centrifuge, and hard plastic liner with cover fasteners for easy sludge handling. Engineered for smaller optical machines, the T06 system has a flow capacity of ~8gpm and filtration down to 1µ. It features an integrated cooling coil. The T10 is suitable for a wider range of optical machines with a higher ﬂow capacity (~25gpm) and supply pump customized to meet various ﬂow/pressure requirements. The T10 has an independent drop-in cooler.

**WHAT'S NEW**

**Polishing Powder & Purify**

How important is purity to achieving higher machining efﬁciency, sub-nanometer Ra, and micro-flatness?

**WASTE MANAGEMENT**

Chilling, ﬁltering, and processing technologies to handle slurry, water, coolants, and process waste.

**AVIATION:**

**PROTECTING YOUR ASSET**

Navigating the Aftermarket of Special Purpose Coatings

Mention coatings in the world of aviation detailing and you’ll be bombarded with information. Some of it on the money – some short-sighted – all of it in the service of protecting the appearance, performance, and safety of the aircraft. For many passengers, a plane’s pristine appearance reasures its airworthiness, an assurance not without merit. Modern design systems and Original Equipment Manufacturer (OEM) coatings, generally known as point, provide the aesthetic and protection to ensure performance under extreme conditions. Fabricated from a variety of materials, aerospace paints is the only type of exterior paint that must handle extraordinary temperature changes, plus moisture, UV light, oxidation, atmospheric pollutants, and aggressive chemical and cleaning materials. Once the aircraft takes to the skies that protection is under attack. At cruise altitude, a shiny appearance becomes lackluster and dull with high levels of UV exposure. The corrosive nature of oxidation disrupts air-ﬂow, degrading performance and compromising air safety. Aircraft maintenance programs, while critical, can be a drain on productivity. After all, aircraft are meant to fly, not sit in a hangar.

**Proliferation of Advanced Materials**

Scrutinizes Process and Technique

Modern manufacturing is challenged by the variety of advanced materials blueprinted into the optical applications that produce smartphones, wearable technology, consumer electronics, advanced defense systems, clean energy, and LED-based lighting, among others. The ultra-hard materials many of these products necessitate (e.g. Silicon Carbide, Gallium Nitride, Diamond, Sapphire, etc.) require innovative processing and finishing techniques to achieve any of a number of speciﬁc characteristics intrinsic to the end product. The ability to manage the application process to speciﬁcation with faster delivery and within a shorter duration, is a sure win/win. It continues to motivate many optics manufacturers to review process, consumables, and equipment. On the process front, chemical mechanical polish...

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For a growing aerospace market demanding increased performance, improved aesthetics, and higher productivity, aftermarket coatings, a.k.a. special purpose coatings, offer the best solutions. Leading the charge is the exterior applications segment; a divergent group focused on establishing a hydrophobic barrier and shielding against UV damage. Characterized by being “field-applied,” as opposed to applied in an OEM factory setting, many are marketed as permanent/permanent solutions. However, all must acknowledge that any coating’s lifecycle is contingent on operational characteristics, region(s) of flight, time in the air, and maintenance frequency. Kevron-based paint systems, like the ubiquitous clear coat, are favored for color retention and enhanced glass, but there are issues with the weight mil thickness can add. While topcoat technology is improving with an exterior base coat - clear-coat system that speeds application and lessens weight, it requires the invest...

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An often asked question is whether the purity of the polishing powder makes a difference in polishing results. A high purity polishing powder translates to higher cost. So it's no wonder there's interest in knowing whether higher purity powders are necessary to obtain better polishing results. An optical technician is frequently looking to optimize surface finish, flatness, and material removal rate, all within the same application. Since each output responds differently to changes in consumables and process variables, optimizing all at the same time is challenging, but not necessarily impossible with compromise and prioritization.

Many optical technicians have used high-purity polishing powders (98% purity) with improved results. Since the polishing powder/sluurry is the significant input variable, the belief that higher purity powders provide better polishing results is reasonable. However, there are other fundamental properties in the process to consider. First, let's look at calcination. For standard polishing powders, manufacturers of high-purity alumina derive the powders from different chemical precursors to give the powder different final properties. A high-purity alumina powder that is derived from a sulfate precursor will have different kinetics and properties than similar powder purity that is derived from an alkoxide or hydroxide. For polishing applications, different chemical precursors will yield similar physical properties, but with different particle morphology, particle size distribution, frittability, surface chemistry, and other properties that influence polishing results.

In a cost-cutting environment, polishing results can be driven by the manufacturing technique and chemical precursor rather than the purity of the powder. A notable exception is when the chemical precursors being polished (e.g., alumina or silica) are affected by chemical importances, and powders and slurries need to be high purity to avoid any undesirable chemical interactions. To optimize process and minimize cost, you will need to choose the correct abrasive powder that is derived from the appropriate chemical precursor and manufacturing technique.

Advanced Materials: Affecting Application Processes

Increased CMP is finding greater popularity in the optics industry particularly in the service of ultrahard materials. Linked to the semiconductor industry, CMP’s effective planarization process evolved semiconductor fabrication up to twelve layers. Today, its objectives of material removal and surface flatness are put to task on a variety of materials including metals, polymeric materials, and ceramics. CMP is used to derive intermediate powders (~60-70%) produced by the calcination of mixed rare earth raw materials. To be able to make such a powder, the calcination process is augmented to give the powder different final properties. A high purity alumina powder that is derived from a sulfate precursor will have different kinetics and properties than similar powder purity that is derived from an alkoxide or hydroxide. For polishing applications, different chemical precursors will yield similar physical properties, but with different particle morphology, particle size distribution, frittability, surface chemistry, and other properties that influence polishing results.

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Advanced Materials: Affecting Application Processes

In an effort to secure the domestic supply of rare earth minerals (~90% purity) the U.S. government has announced plans for funding construction of refining facilities to be run by commercial enterprises. Rare earth minerals, and more specifically, heavy rare earths are crucial for military and commercial processes, as well as for the defense and military sectors. Rare earth mineral production and its supply of rare earths and continues to take steps to secure control of the market, stocking and holding reserves.

It's a question of being in the right place at the right time. For example, applications like smartphone cover glass rely on dual polishing technology. Fortunately, UPI's expertise in the chemical and mechanical polishing process continues to deliver market-leading products. The precision optics market is always looking for an edge to increase yield and quality, while reducing time and cost. Mike's "be your own biggest competitor" approach to manufacturing, regularly evaluates opportunities for innovation along with processes to streamline. While this is a hallmark of his success in a highly competitive market, Mike will point out that sometimes it's just about being in the right place at the right time.

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