Dentsply K-Cup Powder Delivery

Overview
The currently marketed Cavitron Jet Wave® teeth polishing device demands unnecessary maintenance and clean-up due to powder waste and clogging that results from the current powder delivery mechanism. Clinicians pour sodium bicarbonate polishing power from a bottle into the device’s bowl, which gets pressurized during use so that powder can be delivered. The poured powder is never completely depleted, as there is a small amount left over after each cycle of use. At the end of the day, leftover powder absorbs air moisture, hardens, and clogs the device. The goal of this project is to design a single-use cup that would be sold pre-filled with powder and can be inserted into the bowl, ideally reducing maintenance time and powder waste. The cap of the powder bowl also requires redesigning to be more ergonomic for users.

Objectives
- Design a cup that is compatible with the current powder bowl and reduces powder mess/waste.
- Design a powder bowl cap that is more ergonomic for users than the current threaded design.

Approach
- Dentsply supplied materials needed for testing, including two Cavitron units. Information regarding project also provided on trip to company headquarters in York, PA. Additional testing materials were purchased by the team.
- Customer needs were derived from user reviews provided by Denstply.
- Concept generation and selection were conducted with customer needs in mind and produced a final primary and alternate concept. Patents were taken into consideration during concept generation.
- Models were created of both the primary and alternate design using SolidWorks.
- Cup and cap prototypes were 3D printed in the Learning Factory from SolidWorks .stl files, with complete assemblies finished by hand.
- Each cup design was filled with powder, inserted in the Cavitron powder bowl, and tested under normal operating conditions.
- The performance of each cup was compared to OEM system performance in terms of powder flow rate out of the nozzle.
- The performance of the cups did not meet OEM standards; therefore, a recommendation to alter the current system design was made to Denstply, which could help improve performance.

Outcomes
- Each cup design significantly reduced mess and waste by containing the powder.
- The cups restricted powder supply rate, reducing system performance.
- A recommendation was made to Dentsply to change the position of the powder pickup holes located under the bowl of the Cavitron unit.
- The redesigned cap reduced the finger strength needed for sealing.
- Both cup and cap prototypes provide baselines for additional testing at Dentsply.