OFFICE OF SUSTAINABILITY
CAMPUS SUSTAINABILITY FUND

Forms of Rio Tinto - Progress Report

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Requested Metrics

1 full-scale concrete table structure completed using mine tailings-based concrete mixtures.
Chair mold preparation completed, with final concrete casting and installation remaining.
More than 25 small concrete planters fabricated as part of material experimentation and outreach activities.
10 planters distributed to students and community members to promote awareness of sustainable material reuse and circular construction practices.
3 undergraduate student researchers actively participated in the project throughout the semester.
4 PhD students and additional laboratory collaborators offered volunteer support for project continuation and installation efforts.
Collaboration established between the Civil Engineering program and Banner Medical Sciences laboratories to support bacterial cultivation processes.
Procurement and preparation completed for Sporosarcina pasteurii bacterial cultivation.
Multiple experimental concrete batches produced and tested using mine tailings and bacterial concrete concepts.
Student researchers gained hands-on experience in sustainable concrete fabrication, mold preparation, project coordination, and interdisciplinary research collaboration.
Undergraduate researchers expressed interest in continuing scientific dissemination through the development of a future research paper related to bacterial concrete and mine tailings applications.
Project leadership and continuity maintained despite graduation transitions and student housing limitations.

Project Accomplishments

The project successfully advanced the development of sustainable concrete applications using mine tailings and bacterial concrete concepts while simultaneously creating educational and outreach opportunities for undergraduate students. One of the primary accomplishments of the project was the successful fabrication of a full-scale concrete table structure intended for campus installation. In addition, the team completed the preparation and mold development required for the concrete seating components, leaving only the final casting and installation phase remaining.

The project also produced more than 25 small concrete planters using experimental concrete mixtures incorporating mine tailings materials. These planters became an important outreach component of the project, as several were distributed to students and community members to increase awareness about sustainable construction materials, material reuse, and environmentally

conscious design approaches. The project demonstrated that mine tailings can be transformed into aesthetically functional and educational concrete applications rather than remaining solely as industrial waste material.

Another major accomplishment was the successful coordination of interdisciplinary collaboration despite unexpected logistical setbacks. The project initially planned to use laboratory equipment within the Civil Engineering department for bacterial sterilization and cultivation processes involving Sporosarcina pasteurii. However, during the implementation phase, previously anticipated laboratory equipment became unavailable, requiring the team to rapidly identify alternative laboratory resources outside the department. Through collaboration and professional networking, support was secured from personnel within Banner Medical Sciences laboratories, which allowed the project to continue progressing rather than stopping entirely. This collaboration became an important example of interdisciplinary problem-solving and institutional support.

The project additionally created meaningful educational impacts for the undergraduate researchers involved. Students gained direct experience with material fabrication, sustainable construction research, laboratory coordination, procurement challenges, mold preparation, project scheduling, and collaborative research environments. The project exposed undergraduate students to the realities of experimental research, including adaptation to delays, supply chain issues, and changing timelines. These experiences became valuable professional development opportunities beyond traditional classroom instruction.

Although some final installation components remain incomplete, the project accomplished the majority of its intended goals. The largest delays were not related to a lack of effort or organization from the team, but instead resulted from external circumstances such as delayed chemical shipments, changing laboratory equipment availability, graduation timelines, student housing limitations, and end-of-semester academic workloads. Despite these challenges, the project maintained strong momentum through continued volunteer support and collaboration.

An especially meaningful outcome of the project was the culture of support demonstrated by students and researchers within Dr. Kim's laboratory group. Multiple graduate students voluntarily offered assistance, guidance, and labor support to help ensure the project could continue after the semester concluded. This strong collaborative environment significantly contributed to the resilience and continuation of the project.

The project impacts were generally aligned with expectations in terms of educational value, outreach, collaboration, and sustainable material experimentation. While the timeline for full installation extended beyond the original semester schedule, the project successfully established a strong foundation for continued development, future research dissemination, and long-term campus impact.

Next Steps

Although the grant period has concluded, the project will continue through volunteer-based efforts, alumni involvement, and ongoing collaboration with students and laboratory researchers. The remaining work primarily involves the final casting, assembly, and installation of the concrete seating components and the placement of the completed table structure at the designated site.

Now that the required bacterial cultivation chemicals have arrived, the next major step is beginning the cultivation process for Sporosarcina pasteurii. The cultivation phase is expected to take approximately 3–5 days and will support the continued exploration of bacterial concrete applications and material performance. The resulting findings may contribute to future experimental studies and potential publication opportunities.

Although the original student team graduated or transitioned out of university housing, several students expressed interest in continuing involvement remotely through writing, documentation, and research support. One undergraduate student specifically expressed interest in contributing to a future scientific paper focused on bacterial concrete and mine tailings applications. Once all experimental results are compiled, undergraduate participants will be invited to collaborate on scientific dissemination efforts as co-authors if publication opportunities emerge.

The project manager will also remain involved as a University of Arizona alumna and volunteer contributor. Due to adjustments in employment scheduling, additional time became available to help complete the final installation phase independently and through volunteer coordination. Multiple graduate students and collaborators from Dr. Kim's laboratory additionally offered voluntary assistance during their free time to help complete remaining construction and installation tasks. This continued support will help ensure the project reaches completion despite the end of the formal grant timeline.

The completed concrete furniture and installation components are intended to remain on campus as long-term educational and demonstration pieces showcasing sustainable construction practices and material reuse strategies. Future students and researchers may also use the project as a reference for future experiments involving bacterial concrete, mine tailings, sustainable infrastructure, and alternative cementitious materials.

The project additionally opened opportunities for complementary future initiatives, including:

Expanded bacterial concrete testing and durability studies.
Larger-scale mine tailings concrete applications.
Additional campus furniture or landscape installations using sustainable materials.
Student-led research continuation projects.
Future interdisciplinary collaborations between engineering, environmental science, and medical laboratory facilities.
Scientific publication and conference dissemination opportunities.

Overall, the project will continue evolving beyond the original grant period through research collaboration, alumni support, student involvement, and long-term educational use on campus.

Challenges Faced

One of the largest challenges faced during this project involved laboratory access and equipment availability. Early in the project timeline, the team had coordinated the anticipated use of laboratory equipment for sterilization and bacterial cultivation procedures related to Sporosarcina pasteurii. However, during implementation, the availability of this equipment unexpectedly changed, requiring the team to rapidly identify alternative laboratory spaces and collaborators outside the Civil

Engineering department. This process created delays and forced significant adjustments to the original schedule.

Another major challenge involved procurement and shipping timelines for specialized chemical materials required for bacterial cultivation. One of the essential chemicals necessary to begin cultivation did not arrive until May 13–14, which significantly delayed the start of the bacterial growth process despite the team already being prepared to proceed earlier. Since bacterial cultivation itself only required approximately 3–5 days, the delay was primarily tied to shipping and procurement timing rather than laboratory execution.

The project also coincided with the conclusion of the academic semester, graduation timelines, and final examination periods. Undergraduate student researchers experienced substantial academic responsibilities during the final weeks of the semester, which limited scheduling flexibility for installation activities. Additionally, several student participants lived in university housing and were required to vacate dormitories immediately after finals week, making it impossible for them to remain physically present in Tucson to complete installation work even if they wished to continue helping in person.

Media/Links

Recommendations

Moving forward, the project would benefit from continued interdisciplinary collaboration between engineering laboratories, material researchers, and biological sciences facilities. Establishing formalized partnerships earlier in future projects would help reduce delays associated with laboratory access and specialized equipment needs.

The completed installation should continue serving as an educational demonstration project for sustainable concrete applications and material reuse strategies on campus. Periodic maintenance and inspection of the furniture components should be conducted by future student volunteers or laboratory members to monitor durability, performance, and long-term behavior of the experimental materials.

Future complementary projects could expand upon several areas explored during this initiative, including:

Long-term durability testing of bacterial concrete mixtures.
Expanded use of mine tailings as supplementary cementitious materials.
Development of additional campus furniture or public installations using sustainable concrete technologies.
Research into self-healing concrete systems.
Student-led publication efforts and conference presentations.
Collaboration with architecture and landscape design programs to integrate sustainable materials into public campus spaces.