September 29, 2023

Mr. Reice Haase
Deputy Executive Director
ATTN: Lignite Research Program
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Subject: Semplastics Proposal Entitled "High-Value Products from Produced Water Mineralized via Reaction with Anthropogenic CO_2"

Dear Mr. Haase:

Semplastics is pleased to submit the subject proposal in partnership with the University of North Dakota (UND) Energy & Environmental Research Center (EERC). The application solicits the support of the Lignite Research Program for the execution of a bench scale project to test a technology that takes two waste streams, produced water and carbon dioxide, and makes a value-added product of carbonate ceramic composites for building products while improving the quality of the brine water such that it can be reused rather than disposed of.

The $100 application fee for this proposal is provided. Semplastics is committed to completing the project as described in the proposal if the Commission makes the requested grant. If you have any questions, please contact me by phone at (407) 353-6885 or by e-mail at wgeaster@semplsatics.com.

Sincerely,

William G. Easter
CEO, Semplastics EHC LLC

High-Value Products from Produced Water Mineralization via Reaction with Anthropogenic CO_2

Proposal Submitted to the Lignite Research Council's

Lignite Research, Development, and Marketing Program

Principal Investigator: Walter J. Sherwood, Ph.D.

Date of Application: September 29, 2023

Amount of Request: $100,000

Semplastics EHC LLC

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Point of Contact: William G. Easter

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ABSTRACT

Objective: The objective of this project is to develop and demonstrate a cost-effective method to mineralize sodium and other Group 1 elements as well as Group 2 elements in produced water with high levels of total dissolved solids (TDS) while capturing and sequestering carbon dioxide (CO_2). The project will demonstrate a laboratory-scale process for the production of commercially useful products from sodium, lithium, and Group 2 (divalent elements such as calcium) carbonates formed by the mineralization of captured CO_2. These carbonates will be utilized to produce samples of building products such as panels, coated mixed carbonates (MxC) in polypropylene, and sodium bicarbonate or other commercially useful sodium compounds.

Expected Results: The key outcome from this study will be a process to combine two waste streams to produce high-value materials and products while permanently sequestering significant amounts of CO_2. This process uses no toxic inputs and produces no toxic waste streams, but rather results in water that can be utilized beneficially. This result will be accomplished by performing a proof of concept at bench scale through (1) design and construction of a system able to mineralize up to four kilograms of CO_2 per day, producing divalent carbonates such as calcium carbonate and softened brine which will be used to mineralize additional CO_2 to produce sodium and potentially lithium compounds; and (2) initial design of a larger scale mineralization system capable of mineralizing over ten kilograms of CO_2 per day, utilizing CO_2 from an actual combustion source.

Duration: 12 months (September 25, 2023 – September 24, 2024).

Total Project Cost: The proposed total cost is $356,494, with Semplastics contributing $256,494 as cash cost share and $100,000 requested from the Lignite Research Program (LRP).

Participants: The project lead for the proposed project is Semplastics, with the project conducted in partnership with the North Dakota Industrial Commission (NDIC) through LRP, and the University of North Dakota (UND) Energy & Environmental Research Center (EERC).

PROJECT SUMMARY

Semplastics proposes to develop a cost-effective method to mineralize sodium and other Group 1 elements as well as Group 2 elements in high-TDS produced water to capture and sequester carbon dioxide. This result will be accomplished by designing and constructing a laboratory-scale process for production of commercially useful products from sodium, lithium, and Group 2 (divalent elements such as calcium) carbonates formed by the mineralization of captured CO_2. These carbonates will be utilized to produce samples of building products such as panels, coated mixed carbonates (MxC) in polypropylene, and sodium bicarbonate or other commercially useful sodium compounds. Additionally, with our project partner, the EERC, a scaled-up design for a larger pilot system will be produced based on information obtained from the bench-scale system and experimental results.

PROJECT DESCRIPTION

Objectives

The objective of the project is to develop and demonstrate a cost-effective method to mineralize sodium and other Group 1 elements as well as Group 2 elements in produced water with high levels of total dissolved solids (TDS) while capturing and sequestering carbon dioxide (CO_2). The project will demonstrate a laboratory-scale process for the production of commercially useful products from sodium, lithium, and Group 2 (divalent elements such as calcium) carbonates formed by the mineralization of captured CO_2. This system will be used to produce samples of building products such as panels, MxC in polypropylene, and sodium bicarbonate or other commercially useful sodium compounds. From the lessons learned in developing the bench scale system, the EERC will perform initial design of a larger-scale pilot scale system capable of using actual combustion exhaust as the CO_2 source.

Methodology

This project will be performed in seven separate tasks. The proposed study has a 14.5-month period of performance.

Task 1.0 – Design and Build Lab-Scale Mineralization System

The lab-scale system will be able to mineralize up to four (4) kilograms of CO_2 per day. It will be designed to produce divalent carbonates such as calcium carbonate and softened brine which will be used to mineralize additional CO_2 to produce sodium and potentially lithium compounds. Components will include a reaction vessel, pumps, piping, support structure, thermocouples, liquid and gas flow controllers, and a heating system.

Task 2.0 – Evaluate Process Parameters

The lab-scale system will be used to understand, explore, and optimize the process. Parameters to be tuned will include CO_2 input flow rate, divalent & monovalent content of produced water, pH of water, reaction temperature, and removal of iron. Outputs will be evaluated for Group 2 Divalent Metal Mineralization and for Group 1 Monovalent Metal Mineralization. The aim of this task will be to understand the process in order to provide inputs for the design and construction of a larger system.

Task 3.0 – Analyze Produced Water Input and Carbonate Outputs

Under this task, testing will be performed on water and resulting carbonates from two sources: Bakken and the Permian Basin. Input and output water will be tested for compositional analysis. Particle size distribution of both the mixed divalent and monovalent carbonates will be carried out to determine the best mix design for incorporation with resin systems.

Task 4.0 – Produce Test Panels and Carbonate Filled Plastics

For this task, composite plates will be produced that incorporate the carbonates produced with the lab-scale system. These materials will be mixed with Semplastics-proprietary resins using a proven process to produce sample materials that could be developed into replacemnts for conventional building materials. The aim of this task is to determine how the carbonates from various water sources affect the strength and porosity of the composites. Mixed carbonates will also be demonstrated as a filler in polypropylene to demonstrate other beneficial uses. New resin formulations will be developed as needed to improve material properties or to decrease overall cost of the materials.

Task 5.0 – Test Components and Materials

In this task, we will evaluate coatings of mixed carbonate utilizing scanning electron microscopy (SEM). We will also evaluate the microstructure of the plastic matrix after coated particles are used as filler in polypropylene and look at fractured surfaces to understand bonding characteristics. Flexural and tensile testing of injection molded tensile samples will be conducted. Sample plates will be tested for flexural strength, hardness, density, and porosity, and compared to commercial alternatives.

Task 6.0 – Initial Design of Pilot Plant Mineralization Plant

We will produce an initial design for a larger scale mineralization plant utilizing CO_2 from an actual combustion source based on lessons learned from the lab-scale system design and its performance. The larger unit will target the ability to mineralize over ten (10) kilograms of CO_2 per day.

Task 7.0 – Produce Final Report

This task will encompass all activities related to producing the final report. This will include gathering data from the experimental work, organizing the structure of the report, editing, formatting, and review before the final report is delivered.

Anticipated Results

The process, lab-scale system, and scale-up design produced under this project will support the mission of the Lignite Research Program (LRP) to concentrate on near-term, practical research and development projects that provide the opportunity to preserve and enhance development of our state's abundant lignite resources. Quarterly reports and a comprehensive final report will report the findings of this study.

Facilities, Resources, and Techniques

All work will be performed at facilities owned and operated by Semplastics and EERC using existing equipment. Semplastics will perform the bulk of the experimental work, with assistance from the EERC on analytical methods and system design. The EERC will perform the scale-up design for the larger pilot scale system.

Semplastics will utilize its extensive knowledge and experience gained from over a decade of plastics and composites development. X-MAT®, the Advanced Materials Division of Semplastics, launched in 2013. X-MAT has developed a revolutionary, high-performance material that combines some of the best properties of metals (electrical conductivity), engineering plastics (lightweight) and ceramics (high operating temperature). X-MAT has had several successful partnerships including work with NASA, Space Florida, and the Department of Energy's National Energy Technology Laboratory (NETL). X-MAT's game-changing material has been previously proven in several applications including fireproof roof tiles, lightweight space mirrors, battery electrodes, and 3D-printed ceramics. X-MAT technology can be custom-engineered to fit many specifications and has unlimited potential market applications.

Semplastics' work will be performed primarily at our advanced research laboratory located in the Central Florida Research Park adjacent to the University of Central Florida (UCF), which includes 1,500 square feet of research and engineering space. The research lab has the required equipment to conduct the Semplastics portion of the research, including ovens, furnaces, hydraulic presses, CNC router, and all related equipment and supplies. Analytical equipment for materials characterization and testing includes:

- Shimadzu IRTracer-100 Fourier transform infrared (FTIR) spectrometer
- Shimadzu DSC-60Plus differential scanning calorimeter (DSC)
- Shimadzu TGA-50 thermal gravimetric analyzer (TGA)
- Particulate Systems Particle Insight particle size and shape analyzer
- Atago NAR-1T Liquid refractometer
- Brookfield Ametek DVEELVTJ0 viscometer
- Test Resources 313 Series universal test machine (UTM)

Project administrative services will be provided by Semplastics. The project team is committed to providing all necessary personnel and resources to ensure the timely completion of all activities outlined in this proposal.

The EERC has over 254,000 square feet of laboratory and technology demonstration facilities. Their labs address a multitude of standard and nonstandard tests designed to exceed client needs. They

perform all scales of materials analysis and characterization, using state-of-the-art equipment and experienced staff to provide sample analysis, characterization, and research. Available equipment includes:

- Hitachi SU5000 field emission scanning electron microscope (FESEM)
- VG PQ ExCell ICP-MS quadrapole mass spectrometer with 27-MHz ICP RF generator
- Bruker D8 Advance X-ray diffractometer
- Rigaku ZSX Primus II Wavelength dispersive x-ray fluorescence spectrometer
- EERC-designed and built solvent absorber and stripping system that is used to capture the CO_2 from the flue gas generated by the EERC pilot-scale combustion test furnace

Semplastics and the EERC represent decades of experience in product development and process engineering and design. All project participants have committed the necessary resources to execute this project. These same industry experts have been a part of several novel composite production projects on similarly sized systems within the state of North Dakota.

Environmental and Economic Impacts While Project Is Underway

The proposed work is a bench-scale laboratory study and will not have any environmental impacts to the study area or to partner facilities. The proposed work will, however, change economic impacts through the introduction of a near-term value-added product from the capture and sequestration of anthropogenic CO_2. This process combines two waste streams to produce high-value materials and products while permanently sequestering significant amounts of CO_2. The process uses no toxic inputs and produces no toxic waste streams, but rather results in water that can be utilized beneficially rather than treated as an additional waste stream.

Ultimate Technological and Economic Impacts

Utilization of this technology has the potential to permanently capture thousands of tons of CO_2 per day to make materials useful in industrial applications and construction. This outcome aligns with progress toward Governor Burgum's goal of North Dakota carbon neutrality by 2030 as well as societal

objectives of carbon-negative building construction. The potential products to be made from the carbonates extracted from produced water, such as tiles and siding, will contain 32% by mass of captured CO_2. The process is source-agnostic and can utilize CO_2 from point sources or from direct air capture. If North Dakota is to maintain its current power industry and reach carbon neutrality, it will require an "all of the above" approach when it comes to carbon sequestration. The proposed technology will have a significant impact on carbon sequestration while producing valuable products from a second waste stream of produced water. Implementation of this process in the state at the industrial scale could create tens to potentially hundreds of new jobs to operate facilities that can be sited at produced water injection sites.

Why the Project Is Needed

While the proposed technology is not sequestering CO_2 at the same scale as carbon capture and sequestration (CCS) at large power plants, it can profitably use the "mined" minerals in produced water to make construction materials (e.g., roof tiles, siding) at scale. A 100,000 barrel per day treatment facility could capture more than 400 tons of CO_2 each day, which will certainly move the needle on greenhouse gas emissions. The technology also reduces the use of freshwater in oil and gas production in the state, because the softened brine at the end of the process is made much more useable for recycling into fracturing operations and for beneficial reuse in industrial applications.

STANDARDS OF SUCCESS

This project is a bench-scale project to move the technology from proof-of-concept to a higher technology readiness level (TRL) that will enable the process to be integrated into a more complex system defining all steps required to produce the end product as described previously. As such, the proposed work will move the technology from TRL 3 (experimental proof of concept) to TRL 4 (technology validated in laboratory as a system). This information will then be utilized to initiate the scale-up design for a pilot scale system to move up to TRL 6 (system model development demonstrated in a relevant environment at larger scale). The standard of success will be the laboratory integration of the individual

steps required to produce the final product and the development of the scaled-up system design to be executed in follow-on development work.

BACKGROUND

In proof-of-concept work, Semplastics has already constructed a four-liter reactor in which to add water, CO_2, and caustic solutions while monitoring the temperature of the reaction. This reactor has been utilized in early experiments to produce carbonates from produced water which were then filtered from the residual brine and mixed with a proprietary resin to produce a carbonate plastic composite sample (Figure 1). Additionally, Semplastics has produced many coal ceramic composites for making building components such as bricks, blocks, building panels that have outperformed their traditional market components. With assistance from the EERC, the carbon ceramic composite material production process has been scaled to pilot scale and the material produced has been used to make products to demonstrate the feasibility and performance characteristics of the coal ceramic composites. These experiences enable the Semplastics and EERC team to be successful in moving the proposed technology closer to commercial readiness.

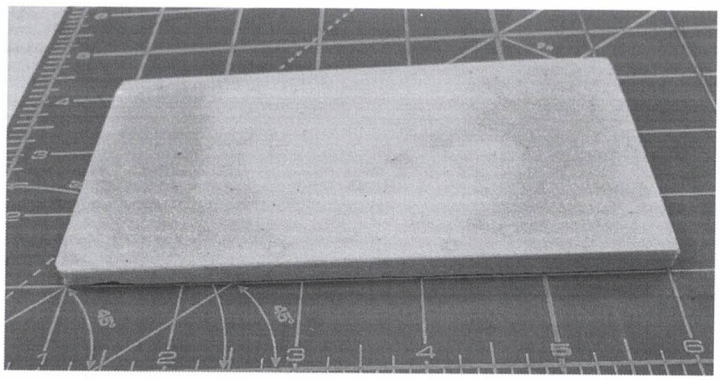

Figure 1. A 3" x 5" x 0.25" MxC-filled inorganic resin panel (~75% MxC by mass).

QUALIFICATIONS

Semplastics will serve as the lead organization for the proposed project. Dr. Walt Sherwood, Semplastics' Chief Scientist, will serve as the Principal Investigator. Dr. Sherwood has been responsible for the development of multiple proprietary resins including the resin systems used to make coal ceramic composites to develop stronger and lighter building products such as bricks and blocks. Dr. Sherwood will ensure that the project is carried out within budget, schedule, and scope. Dr. Sherwood will also be responsible for communication with project partners and EERC project personnel.

Dr. Bruce Folkedahl will be the lead at the EERC to assist in performing the initial scale-up design for the next phase of the technology development. Dr. Folkedahl has worked with Semplastics on many previous coal ceramic composite development projects and has an intimate understanding of the tools and techniques required to pilot-scale such technologies.

VALUE TO NORTH DAKOTA

The proposed project's primary value to North Dakota will be in maintaining and adding new jobs to the state and local economies in areas where current and new regulations threaten to significantly reduce activity in coal utilization, one of the state's most vital resources. The power industry and a newly created carbon capture and sequestration (CCS) industry will preserve and gain new jobs as a result of this project. If the proposed work moves into eventual commercialization, the technology will assist in providing new revenue sources not only for the operating power plants that capture CO_2 but also other sources of CO_2 capture systems such as direct air capture systems, ethanol plants in the state that capture CO_2, and other systems of CO_2 capture. Additionally, the process will aid in reducing the disposal of produced water in oil and gas production and potentially make disposal unnecessary by turning the brine into useful products while improving the water quality such that it can be used in industrial processes. One such use would be to reuse the water in the fracturing process, reducing the need for fresh water and reducing costs.

MANAGEMENT AND TIMETABLE

Semplastics is the lead organization for this project and will oversee all tasks and management activities associated with this project. Semplastics will schedule regular internal and external meetings with project staff and advisors to ensure that the project is conducted using acceptable scientific methodologies and practices in accordance with the project plan (budget, schedule, deliverables, and milestones) and is meeting quality objectives. Semplastics will keep all partners informed of project progress and coordinate activities as necessary for the execution of a successful project and will be responsible for timely submission of all project deliverables and transfer of data and products to the team.

Once the project is initiated, the project team will engage in weekly conference calls to review project status and future directions. Quarterly reports and a final report will be prepared and submitted to project sponsors for review.

The primary deliverable for the project will be a final report detailing all project activities and the successful completion of a laboratory bench scale system illustrating process improvements. The final report will also contain the initial scale-up design of the process to bring it to pilot-scale level in follow-on work.

Milestones proposed for this project are associated with the completion of each task listed in the Methodology section above. The project period of performance is 12 months (September 25, 2023 – September 24, 2024). The proposed overall schedule for this effort is depicted in the table below.

Task	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Task 1: Design and build lab-scale system												
Task 2: Evaluate process parameters												
Task 3: Analyze inputs and outputs												
Task 4: Produce test panels and materials												
Task 5: Test produced components												
Task 6: Design and build larger plant												
Task 7: Produce final report												

BUDGET AND MATCHING FUNDS

The proposed project budget (Table 1) is $356,494, with $100,000 requested from NDIC and matching funds of $256,494 from Semplastics. The budget includes subcontracts for B2K4 Consulting and the EERC, as well as a consultant for Technical and Business Assistance (TABA) services. The requested funding is needed to enable the EERC to support the development of this technology while also supplying North Dakota produced water for use in process development and demonstration. Reduced funding from NDIC will result in reduced scope for process scale-up activities and significantly delay the prospect of moving this technology to market.

Table 1. Project budget.

Project Associated Expense	NDIC Share (Cash)	Semplastics Share (Cash)	Total Project
Labor	$0	$39,120	$39,120
Travel	$0	$3,525	$3,525
Materials	$0	$10,645	$10,645
Subcontractor – EERC	$100,000	$50,000	$150,000
Subcontractor – B2K4 Consulting	$0	$25,060	$25,060
Testing	$0	2,500	$2,500
Consultant – TABA Services	$0	$6,479	$6,479
Fringe	$0	$10,171	$10,171
Indirect	$0	$92,214	$92,214
Fee	$0	$16,780	$16,780
Total Cash Requested	**$100,000**	**$256,494**	**$356,494**

TAX LIABILITY

Semplastics does not have an outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.

CONFIDENTIAL INFORMATION

No confidential information is contained in this proposal.

TECHNICAL REVIEWER RATINGS SUMMARY

LRC (103A): "High-Value Products from Produced Water Mineralization via Reaction with Anthropogenic CO_2"

Submitted by: Semplastics
Principal Investigator: Walter Sherwood
Project Duration: 12 months
Request for: $100,000
Total Project Costs: $356,494

Rating Category	Weighting Factor	Technical Reviewer Rating 34-01	34-02	34-03	Average Weighted Score
Objective	9	4	4	5	
Achievability	9	4	3	4	
Methodology	7	5	4	4	
Contribution	7	3	3	4	
Awareness	5	4	4	5	
Background	5	5	4	4	
Project Management	2	4	4	4	
Equipment Purchase	2	5	5	5	
Facilities	2	4	5	5	
Budget	2	4	4	4	
Average Weighted Score:		207	188	218	**204**

Maximum Weighted Score:	250

OVERALL RECOMMENDATION:

FUND		**X**		**X**	
FUNDING MAY BE CONSIDERED			**X**		
DO NOT FUND					

TECHNICAL REVIEWERS' COMMENTS

1. **OBJECTIVES**

The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Lignite Research Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.

Reviewer 34-01 (Rating: 4) *The concept of utilizing two waste streams to create a useful product is definitely within the intent of the goals. CO_2 is a byproduct of lignite utilization so that fits directly with lignite research*.

Reviewer 34-02 (Rating: 4) *The project proposes to develop cost effective methods to mineralize group 1 elements from produced water and sequester CO_2. As stated, it appears that the activity is being driven by a desire to clean up produced water with an opportunity to sequester CO_2 at the same time. This has potential to benefit ND industry including both oil and gas and power generating units in ND.*

Reviewer 34-03 (Rating: 5) *Bench scale project will attempt to develop a cost-effective way to mineralize elements in wastewater with high dissolved solids in combination with sequestered CO_2 to produce carbonates for use in making usable building products.*

2. **ACHIEVABILITY**

With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or 5 – certainly achievable.

Reviewer 34-01 (Rating: 4) *This work is clearly in the research stage. The tasks being evaluated under this proposal are defined, budgeted, and scheduled as such.*

Reviewer 34-02 (Rating: 3) *Based on the information given it appears likely that the team will most likely be successful in achieving their goals with the budget and timeline noted.*

Reviewer 34-03 (Rating: 4) *The 12-month project for $356,494 is likely achievable given the tasks and experience of the members. $100,000 or 28.1% of this bench scale project is being asked of the NDIC.*

3. **METHODOLOGY**

The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.

Reviewer 34-01 (Rating: 5) *The nature of the work to be performed here is similar to previous work that the parties to the proposal have done before. LRC has worked with EERC on numerous projects, and we can have confidence in their work product. Semplastics also has applicable experience.*

Reviewer 34-02 (Rating: 4) *The methodology noted will mostly result in a successful project.*

Reviewer 34-03 (Rating: 4) *Seven tasks have been laid out in detail with appropriate team members identified for them. Detail and experience of the team members/facilities makes for a likely positive outcome.*

4. **CONTRIBUTION**

The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Lignite Research Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.

Reviewer 34-01 (Rating: 3) *This work utilizes a byproduct of lignite utilization so even at commercial scale would not create a large demand for influencing utilization of lignite.*

Reviewer 34-02 (Rating: 3) *This reviewer believes the project could very likely be successful in achieving its goals. My question is how applicable will those results be to the lignite industry. First of all, there are no estimated economics given so it's not possible to compare this to other options. It would be good to know if it's economical on its own or would a tipping fee be required. Second, they state that both waters from ND and Texas will be used in the study. How will the economics in each case compare? Certainly, if the Texas water is superior in terms of performance, then that's where development would occur. I don't believe that would impact ND CO_2 emissions. If it is successful with ND produced waters, they state that a plant would be situated at an existing produced water treatment facility which would require a pipeline from a plant with a CO_2 capture system. How would the value proposition from this technology compare to other options for using the CO_2 product from the plant.*

Reviewer 34-03 (Rating: 4) *Utilization of high solid wastewater from various sources including fracking in combination with sequestered CO_2 to produce salable products has the potential to benefit more than one ND goal as well as increase valued jobs.*

5. **AWARENESS**

The principal investigator's awareness of other current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 34-01 (Rating: 4) *Both Dr. Sherwood and Dr. Folkedahl are well qualified for this work.*

Reviewer 34-02 (Rating: 4) *The information in the proposal indicates the Team is aware of current work in this area.*

Reviewer 34-03 (Rating: 5) *Dr. Walt Sherwood, Semplastics, has developed proprietary resins, plastics, composites and worked with the DOE, NETL, and NASA in the past. They have already worked with a four-liter reactor in their Lab.*

6. **BACKGROUND**

The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer 34-01 (Rating: 5) *Both Semplastics and EERC have facilities and other staff that are capable of supporting the principal investigators in their work.*

Reviewer 34-02 (Rating: 4) *There is limited information on the background of the principal investigator. The experience of the EERC is very good and well known.*

Reviewer 34-03 (Rating: 4) *Dr. Bruse Folkendahl, EERC, will lead EERC's involvement and will assist with analytical methods and scale-up design.*

7. **PROJECT MANAGEMENT**

The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the parties involved in the project, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.

Reviewer 34-01 (Rating: 4) *The proposed budget and timeline are achievable.*

Reviewer 34-02 (Rating: 4) *The project management plan includes a milestone chart that will allow the sponsors to remain informed on progress and challenges with the proposed work.*

Reviewer 34-03 (Rating: 4) *The tasks are well defined. Milestone chart, schedule, financial plan and communications via reporting at each task and final report also mentioned. All elements above were included in the proposal.*

8. **EQUIPMENT PURCHASE**

The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer 34-01 (Rating: 5) *None identified.*

Reviewer 34-02 (Rating: 5) *No equipment will be purchased.*

Reviewer 34-03 (Rating: 5) *$10,645 for materials is in Semplastics budget but none required by NDIC's budget.*

9. **FACILITIES**

The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer 34-01 (Rating: 4) *The existing facilities and equipment are suitable for completion of this project.*

Reviewer 34-02 (Rating: 5) *The facilities at Semplastics and the EERC are very good and include all equipment required.*

Reviewer 34-03 (Rating: 5) *Both Labs and equipment to complete the tasks already exist at Semplastics and EERC.*

10. **BUDGET**

The proposed budget value relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value.

Reviewer 34-01 (Rating: 4) *The proposed support from the lignite research program is equivalent to the budget amount allocated to the subcontract with EERC. That along with the overall budget for the project suggests that ND will get value for the commitment.*

Reviewer 34-02 (Rating: 4) *The financial commitment from Semplastics is significant as the request is for $100,000 from NDIC out of a budget of over $350,000. This provides for good leverage of the requested funds.*

Reviewer 34-03 (Rating: 4) If the team can succeed with combining the high dissolved solid wastewater with sequestered CO_2 the potential is high for the utilization of waste to salable building products.

OVERALL COMMENTS AND RECOMMENDATIONS:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 34-01 (Rating: FUND) *This project definitely falls into the research category of technology development. It may be hard at this point to visualize a pathway all the way to commercialization, but I applaud Semiplastic for the innovative concept and undertaking this work to establish the foundation on which further development would be based.*

Reviewer 34-02 (Rating: FUNDING MAY BE CONSIDERED) *The proposed work offers the potential for significant value for the energy industries in North Dakota. The governor has challenged the energy industry to be carbon neutral by 2030. This is a significant challenge for the fossil fuel industry and will require significant development work to identify opportunities to change how things are done while allowing for the availability of low-cost energy to meet the needs of the state. Finding ways to look at CO2 as a resource instead of a problem will be key to success in this endeavor. As I look to the proposed work, I struggle with the connection to the lignite industry as compared to the larger fossil fuel industry. Therefore, I agree the work offers significant potential value. I am questioning if it is appropriate for Lignite Energy funds to be the only source of funds for this work. I would suggest funding can be considered.*

Reviewer 34-03 (Rating: FUND) *There is a minimum of risk for the State of North Dakota to assist Semplastics and EERC to bench scale this project because the potential to convert waste stream into valued construction materials while creating valued jobs could be a decent reward. Only 28.1% ($100,000) is being asked for of the NDIC which will go directly to EERC for their tasks on the project. Both Semplastics and EERC have the experience and facilities to accomplish this bench scale evaluation. All elements for a successful proposal are there so I would recommend funding this project.*