Road Gold Company, LLC

Production of Ultra Low Sulfur No. 4 Fuel Oil (ULSFO) from Asphalt Shingles

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April 17, 2021

Agenda

- Value proposition - **1 gram of asphalt shingle generates 16 ml of USLFO**,
- Environmental footprint of asphalt shingles,
- Phase out of bunker fuel as part of Sulfur 2020 campaign,
- Magnified view of the sand and grains on the other side of the shingles,
- Amount of oil produced after 2 days,
- Amount of asphalt left in the shingle,
- Scaling up the process by re-purposing an existing FOWA unit.
- Back-of-the-envelope calculations based on bench-scale tests.
- Support for cleanup of spills for producers.
- A schematic for a larger unit that can process larger volumes of asphalt shingles.
- Next steps

Value Proposition/Takeaways

According to a 2007 study conducted for the United States Environmental Protection Agency (USEPA), the amount of asphalt shingle waste is significant and only about 10 % is being recycled. Specifically,

- Approximately 11 million tons of asphalt shingle waste is generated in the United States annually.
- The current recycling methods recycle about 1.1 million tons, leaving about 9 million tons to landfill.

A bench-scale study shows production of 750 ml from 45.0 gms that was later corroborated by testing inside a re-purposed FOWA unit -

- 750 ml of ULSFO from 45 grams of (single-sided) US asphalt shingle
- 750 ml of ULSFO from 25 grams of (single-sided) Canadian asphalt shingles.
- Scaled the process by re-purposing a FOWA unit produced 3.785 liters from 212 gms.

Shingles - Environmental Impact and Composition

Shingles are used for roofing in most residential constructions. Every year these shingles need to be disposed of as a matter of operations and maintenance. According to the USEPA's report, the disposal of these shingles is usually at landfills, which poses a near-term and long-term environmental risk. Our value proposition is to achieve remediation of these shingles while extracting fuel oil. The rest of the document presents the quality of oil produced along with a couple of proposals on maintaining the chain of custody using blockchain ledgers such Zilliqa and Tezos.

- A thin base fibreglass sheet,
- **Asphalt layer - Component of Concern (COC) for this project**, and,
- Colored stone granules - (some of the granules are colored to reflect light.)

Emerging Market for ULSFO

Environmental issues are both global and interconnected; the recent directive by the International Maritime Organization (IMO) to reduce sulfur oxide emissions in 2020 as part of the Sulfur 2020 campaign presents a unique opportunity for a new source of low-sulfur No. 4 fuel oil produced as a result of remediation of asphalt shingles.

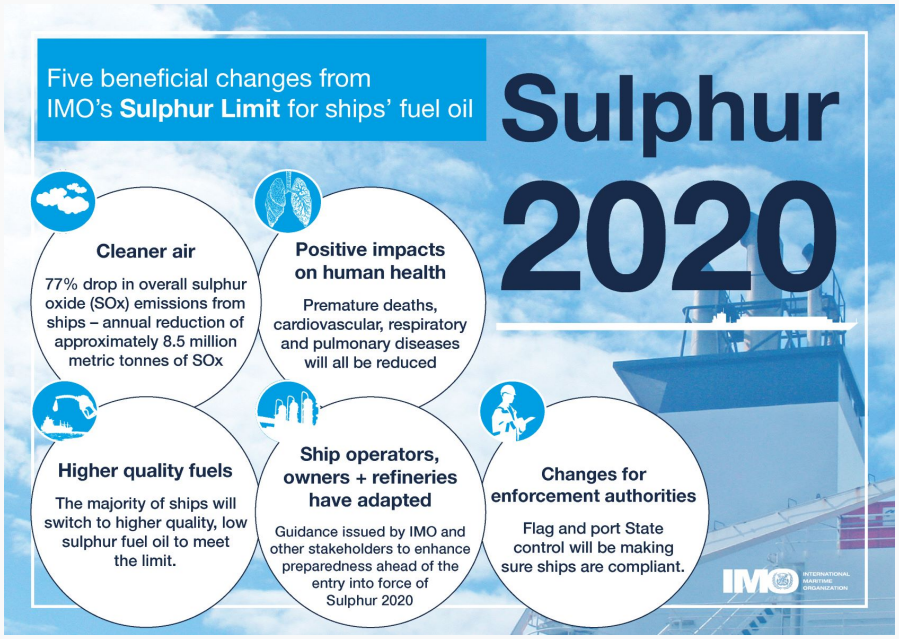


Figure: IMO Sulfur 2020 Campaign

Production of Fuel Oil

Figure: Oil collected within an hour of adding VaporRemed.

A strip of shingle measuring 6.5 cms x 6.0 cms and weighing 0.045 grams was placed in a beaker so that the asphalt side faced outside and granule side faced the wall of the beaker. [a] A light splash of diesel is sprayed on the asphalt surface, followed by spraying VaporRemed and water.
[b]

[a] Our bench-scale tests used asphalt shingles with asphalt covering a single side.

[b] All of these changes to viscosity are achieved at *room temperature*.

Results of the oil analysis

Analysis of the oil produced from waste shingles was carried out using ASTM specification D 396 and the values are given below.

- Total sulfur : 291 ppm
- Flashpoint : 67 °
- Water content : 2.0 %
- Kinematic viscosity : 2.681 cst
- Ash content : 0.019 %

Market Overview for ULSFO

The generated oil is classified as *ULSFO*. IMO's Sulfur 2020 campaign presents an opportunity to supply the low-sulfur fuel oil as a replacement for bunker fuel in the global market.

Ref: DLA:2019-09-30-072433-663.

Date	Product	Price (in USD per gallon)
Dec 2019	Intermediate Bunker Fuel Grade Oil	3.06

Projected Generated Volume of No. 4 Fuel Oil

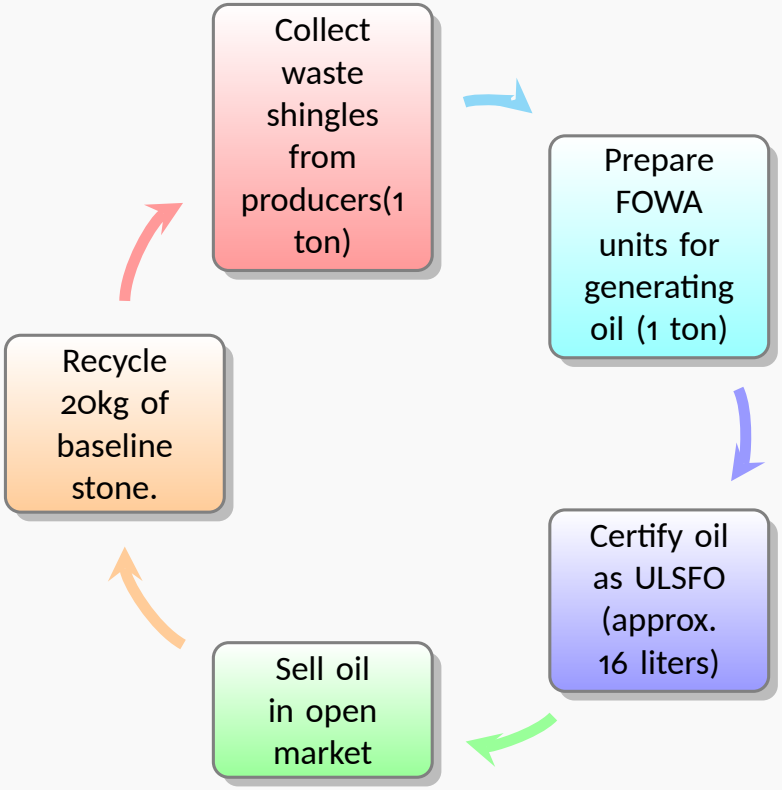
We estimate the yield of oil to be about 16 milliliters (ml) per gram of shingles. We present our projections based on the numbers from our bench-scale tests.

Wt. of shingles (g)	Yield (L)	Market Value (USD)
1000 gms	16.66	13.474
1 ton	16,666	13,474.24

Assumptions

- Market price of ULSFO in USD : 3.06
- 1 gallon = 3.785 L.
- Process lossage is within 20 % of the bench-scale tests.

Process Overview for 1 Ton of Waste Shingle



- At the end of each step, a smartcontract would be executed for certification on a public blockchain to participate in a carbon-credits market.
- We propose to develop a mobile application that supports global platform specification to support crypotographically secure signatures for wallet operations.

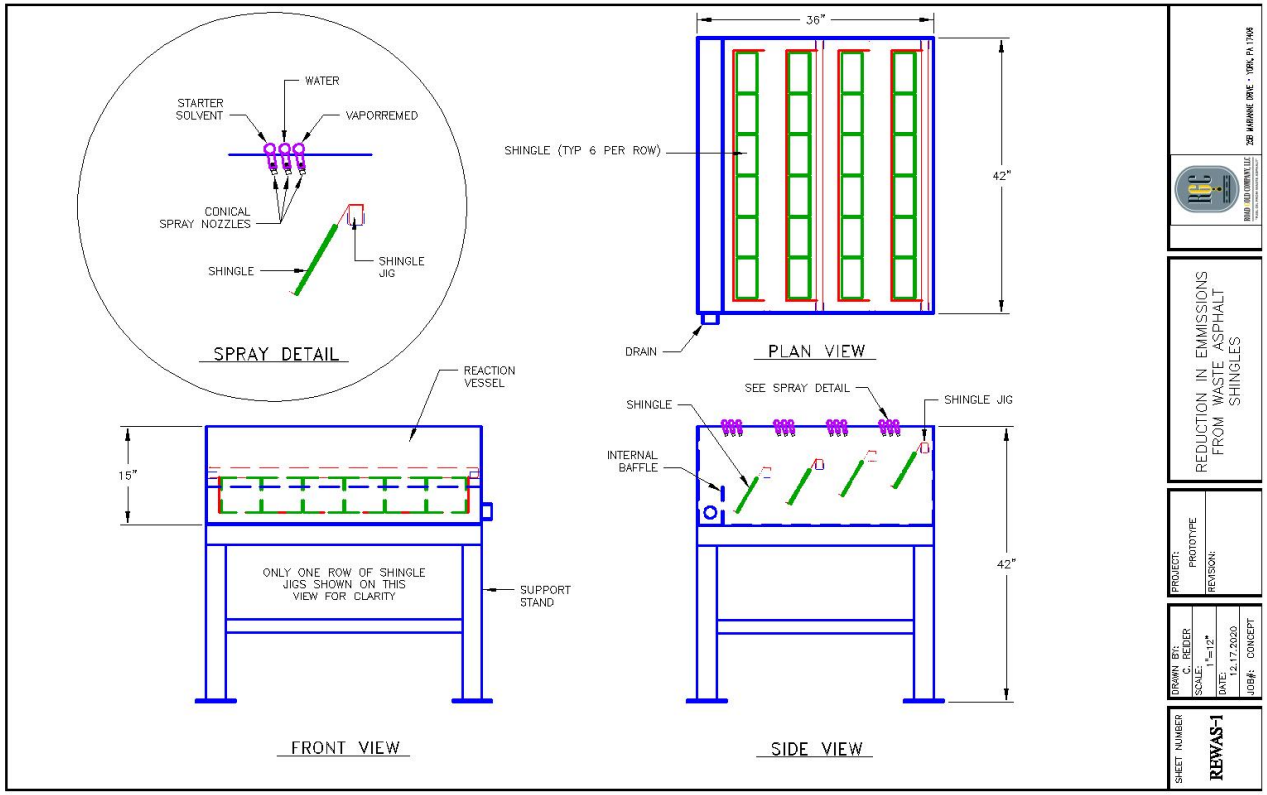
- Today waste is collected at about USD 450 per ton.
- Processing of FOWA - (2 persons per 1 ton unit.)
- Scheduling inspections for inspection reports.
- Production and distribution of oil.
- Recycling the base stone component of the shingles.

Industry Partnerships - Sarva Bio Remed, LLC

Sarva Bio Remed, LLC has been developing innovative products, consulting with environmental agencies, consultants and homeowners to solve their oil contamination problems for over a decade. Road Gold has an exclusive agreement with Sarva Bio Remed LLC, to supply spill cleanup bioremediation products.

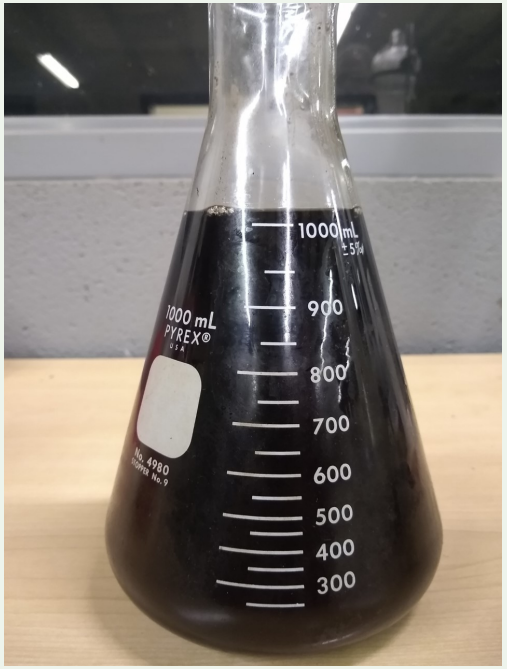
Reduced Emissions from Waste Asphalt Shingles – REWAS-1.0

We present a schematic for a scaled-up model of a REWAS-1.0 unit.



Summary/Vision

The following images show the summary of what we have accomplished in our bench scale tests and we believe helps outline the potential to produce oil at scale.



Next Steps - Vision/Objectives

Next steps-Vision

What we presented above are the results of our bench-scale tests and a proposed schematic for a prototype. These results are quite encouraging as the amount of oil produced was close to 280 ml from a shingle weighing 0.045 g.

Near-term Objectives

Our initial vision is to help the industry cleanup approximately 10,000 lbs of asphalt shingles per year.

Vision (contd)

We present a road map to take our process to market. We have outlined the following next steps to help us commercialize the process and meet the expected demand:

- Modify the current prototype to suit the current physical state of a shingle squares. The challenge is to limit any pre-processing of shingles before they enter the recycling stream.
- Set up partnerships with bunker fuel oil consumers and distributors.
- Add network-enabled flow-control units to publish the oil produced from each unit for statistics and analytics (this is important to help us optimize our pipelines.)

Vision (contd)

- Create a recycling audit application that attributes each shingle to its original source for carbon accounting.
- Create a mobile application used by oil inspectors to certify a production unit and tie it to the source of shingles that publishes this information on public available blockchain networks for reliable audits, such as
  - Tezos, a blockchain supporting amendable ledgers.
  - Zilliqa, a ledger supporting low-cost fast transactions.

  Note: this information might be published in two forms: a public version that suppresses the producer's information, and a private version that the shingles producer can use to support their carbon footprint reduction.

Executive Team

Gnanu Ayysola, Co-founder

Satya Ganti, Chief Technology Officer

Dinkar Ganti, VP - Operations

References (please click for details)

- Energy efficient method for recovering oil from asphalt waste utilizing bioremediation
- Campaign to cut down Sulfur emissions - 2020.
- Tezos - A blockchain with amendable ledger and support for provable smart contracts
- Zilliqa - A blockchain ledger supporting high performance transactions while keeping the transaction costs low.
- USEPA Report on Recycling of Waste Asphalt Shingles
- ABS Marine Fuel Advisory Report
- A Reuters report on the impact of marine fuel prices due to IMO Requirements.
- Asphalt Roofing Shingles Into Energy.

Next Steps

Next Steps

We would love to hear from you, please reach out to us at this sales@roadgoldcompany.com.

Results

Scaling of the bench-scale tests was carried out using three 6”x 4” shingles collectively weighing close to 212.0. They were treated with the standard process to check the output as shown below. Almost 1 gallon of fuel was produced.

- A shingle was placed in a beaker so that asphalt side faces outside and the granule side faced the wall of the beaker.
- A light splash of diesel is sprayed on the asphalt surface, followed by adding VaporRemed and water.
- A beaker showing 280 ml of oil extracted from the shingle.

Shingle	Initial wt.(gms)	Final Wt.(gms)	Asphalt(gms)	% Asphalt
Shingle 1	77.71	2.99	74.72	96.15 %
Shingle 2	68.78	2.68	66.10	96.10 %
Shingle 3	66.31	3.90	62.41	94.11 %
Total	212.80	9.57	203.23	95.50 %

Table: This cold-water process produces (approx.) 16 ml of ULSFO from 1 gram of asphalt shingle.

Fig:2 Approximately 100ml of oil collected after 2 hours

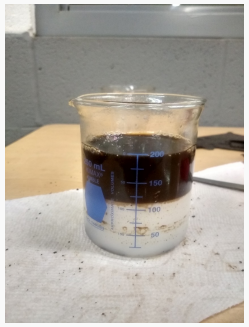


Fig:1 Oil released after first cycle

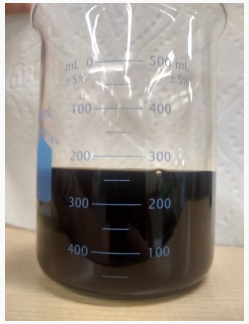


Fig:3 Approximately 280 ml of oil collected in a beaker

Results - contd.

Fig:1 Pre-processed Shingles

Fig:2 Oil Released from Shingles

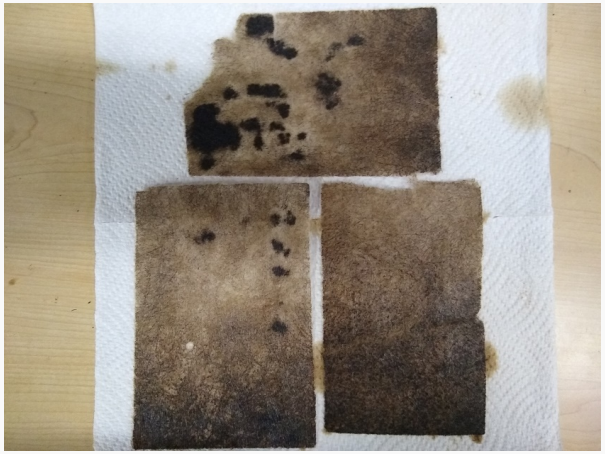


Fig:3 Shingles after Removing Oil

Thank you for your time!