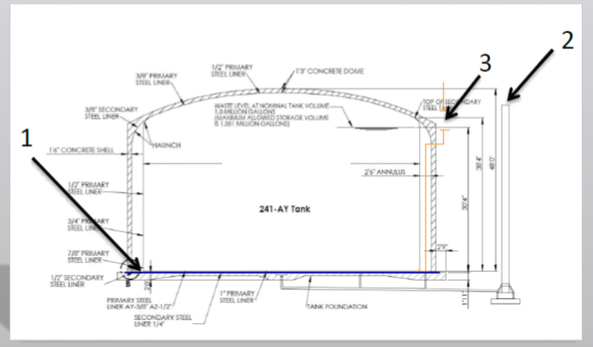
CURRENT STATUS OF MINIATURE MOTORIZED INSPECTION TOOL FOR DOE HANFORD SITE TANK BOTTOMS

Ryan Sheffield – DOE Fellow, Hadi Fekrmandi, Ph.D. – Mentor
Florida International University

Background

Recently, small amounts of waste have been found in the annulus of tank AY-102, prompting the need for developing inspection tools that can identify the cause and location of the leak. Three separate access paths can be used to obtain information regarding the tank bottom conditions. The inspection may be conducted via:

- 1) Refractory air slots through the annulus
- 2) 4” annulus air supply pipe to central air slots
- 3) 6” leak detection pit drain from the central sump

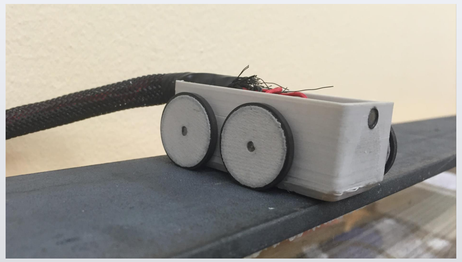


Objectives

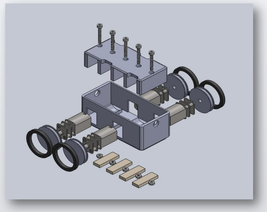
There are various environmental and physical constraints which the tool will have to adhere to. In order for the tool to be successful, it must be capable of the following:

- Travel through small cooling channels with dimensions as small as 1.5” x 1.5”
- Provide live video feedback
- Produce enough torque to overcome the tether drag force
- Inverted travel to avoid obstacles such as tank corrosion
- Navigate up to 38 feet to the tank center, while maneuvering through four 90° turns

Prototype Improvements



Assembled model

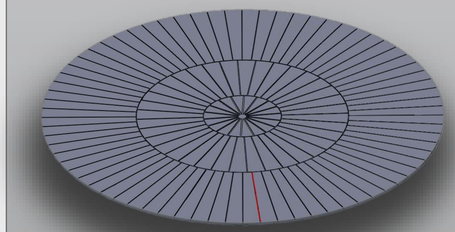


Exploded view

A model of the inspection tool has been designed, assembled and tested. Areas of potential performance improvement were observed and became the basis of the subsequent design. The changes included:

- In-house manufactured wheels to reduce width
- A larger motor, capable of 10x the amount of torque
- Wheel diameter was increased by 6 mm to allow for increasing obstacle avoidance ability
- Brackets allowing for motor swap in the event of a motor failure
- Motors that implement metal gears versus plastic gears

AY-102 tank info



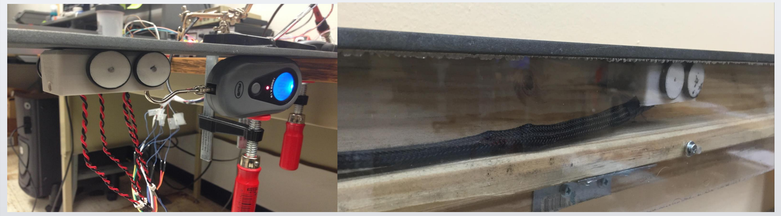
Tank cooling channel arrangement

The tank configuration through which the tool will have to maneuver includes the following:

- 72 outer ring slots (1.5”x1.5”x17’)
- 36 ring slots (2”x1.5”x12 ‘)
- 18 inner slots (3”x1.5”x7’)

Actual images of cooling channels representing expected conditions

Lab Testing



Maximum force testing (left), lab scale test bed testing (right)

Milestones:

- Successful navigation of the first 18 feet of the lab scale test bed
- Maximum pull force of 5.3 lbs

Components

The components that make up this design iteration are the following:

- Arduino Uno board with ATMega328 microcontroller
- Joystick shield kit for the Arduino Uno
- Eggsnow USB Borescope Endoscope 5.5 mm inspection camera
- 298:1 Micro Metal Gearmotor (4)
- 3D printed 20 mm x 2 mm wheels (4)
- 3D-printed body
- Neodymium magnet - 1” x 3/8” x 1/16” – 4.53 lb pull force (4)

Looking forward

Further lab scale testing will be performed to verify the inspection tool‘s abilities. A full scale test bed will be designed and constructed to emulate the inspection tool entering the tank approximately 45 ft. down and entering the refractory cooling channel. Success in a full scale test bed will be indicative of its ability to enter and inspect tank AY-102.

Acknowledgements

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