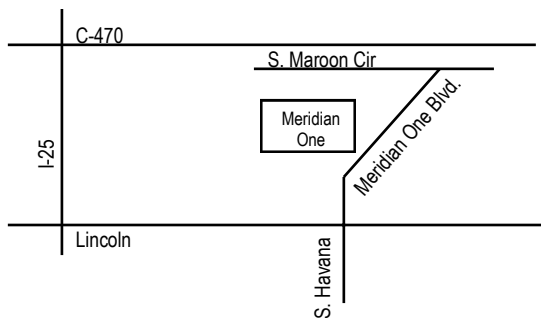




WE'VE MOVED!

Continental Research and Engineering, LLC (CR&E) recently moved our Denver office to 9785 South Maroon Circle, Suite #100, Englewood, CO 80112. The move located us in the Meridian International Business Park, which is easily accessed from all major Denver arteries and is just minutes south of the Denver Technological Center. The office is quickly reached from the airport and within the next couple of years will have a light rail connection within ¼ mile of the building. The new office gives CR&E the necessary room for future expansion of the company. CR&E invites all our clients to visit us at our new location.



PLEASE VISIT OUR NEW WEBSITE AT:
www.cre-denver.com



SECONDARY WASTE TREATMENT INVESTIGATION

The Problem

Secondary waste generated while storing and processing chemical warfare weapons can significantly increase processing schedules. CR&E has successfully completed a phase-one evaluation of technology alternatives for processing secondary wastes at the Tooele Chemical Agent Demilitarization Facility (TOCDF). TOCDF has a large quantity of secondary wastes requiring disposal. These wastes have been generated through agent storage and disposal operations. The technology alternatives evaluated would either supplement or replace waste processing in the existing TOCDF furnaces.



The following two general categories of secondary waste that are in need of treatment and/or disposal:

- Various agent-related secondary wastes have been generated during storage activities at the stockpile site. These consist of a variety of mixed liquid and solid wastes including: metal parts; dunnage (wooden pallets and packing boxes used to store munitions); and miscellaneous wastes {plastic sheeting, Demilitarization Protective Ensemble (DPE) suits, depot monitoring equipment, filters (including carbon) from storage bunker ventilation systems and other wastes}.
- The second category consists of the secondary wastes generated during normal disposal facility operations.

The TOCDF and Deseret Chemical Depot (DCD) have a significantly greater quantity of secondary waste requiring processing than any of the other operating demil facilities. Current projections indicate that TOCDF/DCD will have approximately 5,000,000 pounds of hazardous secondary waste that must be processed. There is significant risk to the TOCDF closure schedule dependent on the

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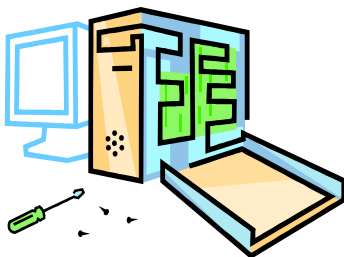


disposal methodology utilized for treatment of these wastes. Disposal of these materials exclusively through the TOCDF Metal Parts Furnace (MPF) could create an unbudgeted extension to the duration of activities at the site.

The Solution

CR&E utilized their experience with analyzing and classifying agent-related demilitarization wastes to determine treatment requirements for each of the wastes. Then, CR&E's personnel applied their knowledge of the existing TOCDF furnace processing capabilities to estimate the capabilities of the existing furnaces to process the waste in a timely manner. Finally, five alternate technologies were investigated and evaluated for their ability to treat the secondary wastes in combination with the existing TOCDF furnaces.

The broad experience of CR&E personnel with various forms of high temperature treatment of waste materials was employed to review the five technologies. Vendor information was solicited and combined with available development and operational data to determine the ability of a technology to adequately treat the secondary waste stream components. Equipment, installation, and operational costs were estimated. CR&E then made an experienced-based determination of which technology would best meet the needs of TOCDF. The initial results of the investigation were compiled into a report and submitted to EG&G Defense Materials Inc. (EG&G). This project is continuing to include additional details and additional technologies.



JACADS PDAR

Collection and storage of plant operational data at the JACADS was accomplished with the Process Data Acquisition and

Reporting (PDAR) system. From about mid -1994 to the close of the project in 2003 the PDAR system stored data every three seconds for approximately 900 analog instruments and 130 Agent Collection And Monitoring Systems (ACAMS). This data was

stored in a binary format along with alarm and discrete event history in a compressed file each day. CR&E expanded these files, extracted the analog instrument information from the appropriate location in the file, normalized the data, and stored it in a MySQL database. Then a web-based interface was developed to allow a user to select a time frame and series of instruments and download that information in a format compatible for import to Excel and other engineering software tools.

CR&E/REI JOINT INVESTIGATION OF MUSTARD PROCESSING

CR&E teamed with Reaction Engineering International (REI) and Carmagen Engineering, Inc. (CEI) on RIM 65 - MPF Evaluation for Efficient Processing of Un-drained Projectiles.



The objective of the project was an evaluation of the capability of the MPF to process un-drained HD and H mustard projectiles. Sampling of projectiles has shown that the mustard agent has degraded, forming a solid heel that cannot be drained prior to projectile processing in the MPF. Thus, the United States (U.S.) Army needed to determine if the MPF could accommodate projectiles that had not been drained, and if so, the maximum number of projectiles that could be inserted in the MPF per treatment cycle.

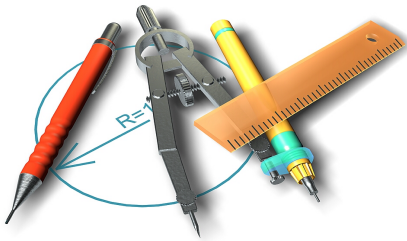
CR&E successfully modeled the vaporization of the liquid and solidified HD and H. The liquid mustard agent vaporization rate was determined by employing CR&E's Peak Vaporization Rate (PVR) Model. The model was developed for the MPF to provide tray vaporization rates as a function of MPF temperature, munition fill level, and time. The model calculations incorporate heat transfer and mass transfer, individual munition geometry, munition placement on trays, and agent physical properties. What makes the model unique is it utilized actual agent processing data from the Johnston Atoll Chemical Agent Demilitarization System (JACADS) MPF to calibrate the results.

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The current CR&E PVR model does not simulate the overall vaporization rate for liquid chemical agent mixed with solids. The numerical model performed by the CR&E Computational Fluid Dynamics (CFD) program can provide the necessary heat and mass transfer for the mixed liquid and solids found in the projectiles. CR&E modeling personnel developed a CFD model to simulate the heating, melting, and vaporization of the solid portion in combination with the vaporization of the liquid portion. The solid CFD model simulates the effect of liquid chemical agent mixed with varying solid mass fractions.

The PVR model output curve for agent vaporization was utilized as an input to the CR&E Mass & Energy (M&E) Balance model. In order to optimize furnace throughput, it was necessary to minimize the tray loading interval within the constraints of 5X requirements and furnace capabilities.



The CR&E M&E balance model is a spreadsheet calculation of mass flows and energy balance. The balance is calculated at 30 second intervals using a quasi steady-

state assumption. That is, at each point in time steady-state is assumed. The spreadsheet calculates, at each point in time, the fuel and water quench flow rates to maintain the set-point temperature based on an energy balance.

The final project step was to determine the effects of the increased mass loading created by the full projectiles being processed in the MPF. CR&E used the CR&E Pollution Abatement System (PAS) M&E balance model which is an extension of the CR&E primary combustion chamber and secondary combustion chamber M&E balance spreadsheet. The PAS M&E model takes the output from the primary and secondary chamber M&E as the input for these balance calculations. The M&E modeling showed that sufficient capacity exists in the MPF PAS to allow increasing the mass of mustard agent processed in the MPF.

PROCESSING SUPPORT FOR THE TOCDF MUSTARD CAMPAIGN

TOCDF requested CR&E to provide planning and design analysis services for support of the TOCDF Mustard campaign. CR&E completed process evaluations of the Liquid Incinerator (LIC) and MPF which will process Ton Containers (TCs) with mixed liquid/solid HD Mustard heels, un-drained 155mm rounds containing H Mustard, and 4.2" mortars containing 5% HT Mustard heels. Design rates and processing requirements for each furnace were determined for the processes evaluated.

CR&E professionals assisted EG&G with identification of facilities design and process changes required for the Mustard Campaign Strategy. The technical assistance included identification of design modifications to the LIC and associated PAS needed for processing the effluent solution from the Ton Container Wash Out (TCWO) system. CR&E developed a methodology for handling the waste stream, including process operating parameters and feed rates.

CR&E professionals reviewed the MPF and associated PAS design for processing TCs with mustard heels. TOCDF conducted both ultrasonic and x-ray testing of the mustard TCs. These tests indicate that the agent within the TCs has degraded and the contents are comprised of both a liquid and cohesive solids. CR&E utilized CFD modeling to evaluate processing requirements for the mixed liquid/solids contained within the TCs. The necessary design modifications and process changes required to safely and efficiently process mustard ton containers with elevated heels were identified. EG&G was then provided with technical assistance to implement the identified changes.

CR&E's evaluation included processing 4.2" HT mortar and 155mm H rounds. The HT rounds are easily drainable with the exception of a small gelatinous heel. CR&E's evaluation concluded the rounds could be processed through the MPF at 96 rounds per tray with 5% heel. The process was limited by a conservative evaluation of trace mercury (Hg) contamination, not thermal capabilities.

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The 155mm H rounds are considered to be at least 60% solid and un-drainable. CR&E's evaluation of the 155mm H rounds concluded that full rounds could be processed through the MPF at 48 rounds per tray.

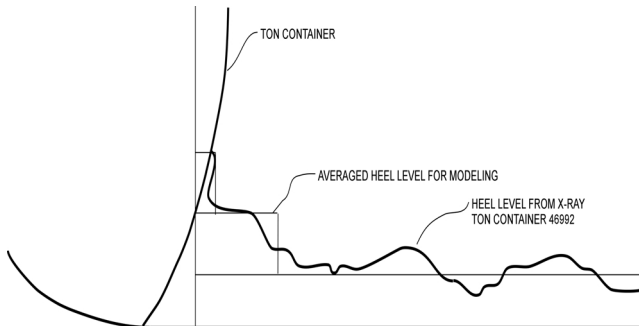


Figure: X-Ray Characterization of HD Ton Container Heel and Approximation for CFD Modeling

REVIEW OF U.S. DEMILITARIZATION PROGRAMMATIC LESSONS LEARNED FOR RUSSIAN DEMILITARIZATION FACILITY AT SHCHUCH'YE

The U.S. Department of Defense initiated the Cooperative Threat Reduction Program to help Russia safely store and ultimately eliminate its chemical weapons stockpile. The Chemical Weapons Destruction Program is accomplishing this goal through construction of a nerve agent chemical weapons destruction complex in Shchuch'ye, Russia. The facility will utilize a MPF similar in design to those used in the U.S. baseline demilitarization facilities.

CR&E personnel have been involved with the U.S. Chemical Weapons Demilitarization Program since the early 1970's. Our involvement includes extensive experience with the design and operation of the MPF. Because of this experience, CR&E was selected by EG&G to review the Lessons Learned experience resulting from operation of the U.S. Demilitarization Program furnaces and to identify items relevant to the furnace design at the Shchuch'ye Demilitarization Facility. The areas reviewed and evaluated included mechanical

design, instrumentation, controls, operations and system safe shutdown criteria.

The MPF systems utilized by the U.S. are proven to provide safe destruction of toxic chemical warfare agents. They are provided with mechanisms to protect personnel and the environment during all operating scenarios. The information provided by this review will assure that the Russian furnace will also operate in a safe and environmentally friendly manner.



NEWPORT PROJECT

CR&E has been actively involved at the Newport Chemical Demilitarization Facility (NECDF) since 2004, supporting systemization and balancing of the Heating, Ventilation, and Air Conditioning (HVAC) systems. CR&E has assisted NECDF's plant staff in preparing the laboratory and plant ventilation system for agent operations.

CR&E's computer modeling group has developed a computer model of the ton container 5X treatment system. The temperature profiles for ton container in the continuous steam treater were profiled to identify the ton container temperature profile. CR&E provided NECDF with thermal dosimeters and a bracket design to hold the dosimeter in the coldest zone identified by the computer model to verify the systems ability to meet the U.S. Army's 5X standards and verify the computer model predictions. CR&E

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field engineers assisted NECDF engineering and operations during 5X testing at NECDF to set up and test the ton container 5X process utilizing information from the computer model. The computer modeling and field-testing has resulted in a successful demonstration of the Newport continuous steam treatment systems ability to meet U.S. Army 5X decontamination standards.

UMCDF AGENT TRIAL BURN SUPPORT

CR&E has been actively involved at the Umatilla Chemical Demilitarization Facility (UMCDF) since 2001, supporting systemization of HVAC, electrical distribution, fire detection and incineration systems. Upon completion of systemization, CR&E personnel assisted Washington Demilitarization Company (WDC) with coordination of the government demonstration tests for HVAC and the incineration systems. CR&E was then tasked to assist WDC with coordination of the surrogate trial burn activities for the LIC, Deactivation Furnace System (DFS) and the MPF. CR&E has also assisted the UMCDF Trial Burn group in presenting incineration process and design information to the Oregon Department of Environmental Quality (ODEQ) and the Environmental Protection Agency (EPA) for permit modifications, testing explanations and validation of incinerator testing. CR&E continues providing incineration expertise for WDC at UMCDF for the 2005 incineration system agent trial burns.

MPF SAFE SHUTDOWN AT ANCDF



Accidental events at two of the Continental U.S. (CONUS) demilitarization sites revealed the existence of some problems in the MPF system's response to unscheduled shutdown events. The hot furnace was not sufficiently isolated from combustion air in the event of unplanned loss of air flow through the system.

Application code from the JACADS control system was examined to determine an historical operational philosophy. Working with

Anniston Chemical Demilitarization Facility (ANCDF) and Washington Group International (WGI) personnel, CR&E developed a written operational behavioral philosophy for major failure events in the MPF. This design behavior was then compared to the existing application code and differences identified. While these discrepancies were modified, CR&E developed a plan to test the modifications to the furnace. CR&E then assisted ANCDF and WGI personnel with execution of this certification test plan.

MPF SHAKEDOWN TESTING AT ANCDF

CR&E personnel assisted ANCDF personnel in tuning the MPF system to accommodate 35% heels of GB agent-filled 8-inch projectiles. This level was chosen as CR&E personnel had personal experience with achieving this goal at JACADS. The ANCDF effort commenced with processing 4% heels. For this effort, tuning of the Zone 1 temperature control loops accomplished the goal of minimizing temperature overshoot and actually eliminated the need for water sprays at this level. Higher heels required both mechanical and software changes to the water spray system. Additionally, timed changes to the Zone 1 temperature set-point were recommended. ANCDF concluded the ramp-up process at 25%. That level was determined to be more than adequate to meet their operational requirements.



VX HYDROLYSATE

The TOCDF is currently preparing for the processing of several waste streams. One of the waste streams is VX hydrolysate. The preferred method for destruction/decontamination is through the MPF. CR&E was recently awarded a contract to provide technical assistance to TOCDF in support of VX hydrolysate processing. CR&E personnel will provide the following information:

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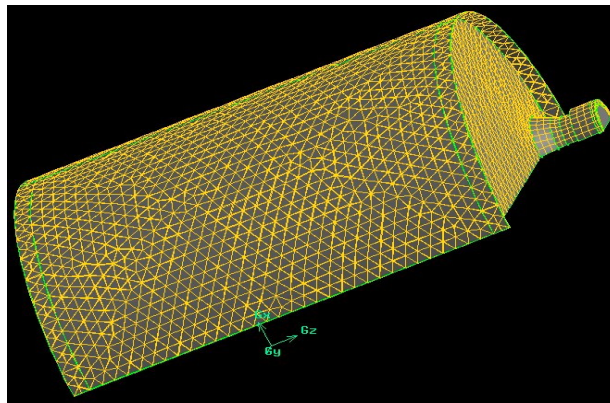
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- Construct a CFD model to identify the melting/destruction point of the processing container's plastic spout and initial vaporization of VX hydrolysate.
- Identify the heating and vaporization rate of the VX hydrolysate during processing through the MPF.
- Identify the maximum processing rate for VX hydrolysate through the MPF.
- Identify a surrogate material for the VX hydrolysate to be used during testing.

Additionally, CR&E professionals will prepare a detailed test plan and assist EG&G at the site during demonstration testing.



The Bulletin is designed to keep CR&E's customers informed of developments, projects and of CR&E's involvement in the national effort to destroy chemical warfare munitions.

For more information on how we may assist you, please contact our office at (303) 758-7373 or e-mail: cre@cre-denver.com.

Continental Research & Engineering, LLC
9785 South Maroon Circle, Suite #100
Englewood, CO 80112
Ph: 303-758-7373
Fax: 303-758-1072