

CAROL ROBOTIC CATALYST HANDLING



Advantages

- Improves worker safety by reducing confined-space entry
- Increases productivity
- Accelerates turnaround time
- Rated for use in Zone 1 and Class 1 Division 2 hazardous areas
- Highly maneuverable
- High-capacity vacuum
- Camera and lighting systems for effective remote control
- Capable of 24/7 operation

USA DeBusk has dramatically increased safety for reactor turnarounds with the introduction of robotic catalyst handling. The Catalyst Removal Amphiro (CAROL) system is the only robotic solution in the U.S. for unloading catalyst from fixed bed inert reactors. The system reduces or entirely eliminates the need for inert confined-space entry during catalyst changeouts.

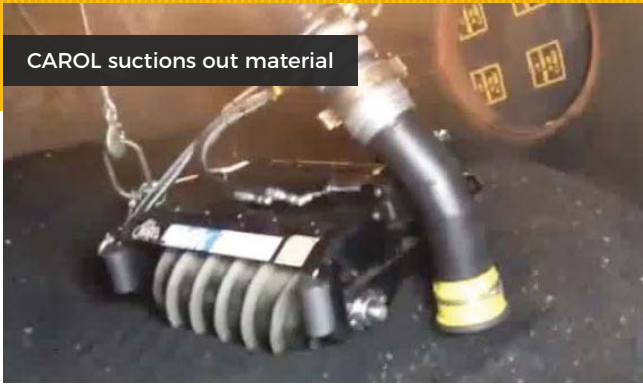
With manual catalyst unloading, workers enter confined spaces under inert atmospheres (typically nitrogen) to manipulate a high-volume vacuum hose while standing on unstable mounds of spent catalyst material. The work is hot, strenuous and extremely hazardous. A study by the U.S. Chemical Safety Board identified 85 nitrogen-exposure incidents in the U.S. between 1992 and 2002, resulting in 80 deaths and 50 injuries.*

The CAROL system eliminates or substantially reduces the need for manned entry into inert reactors.

*U.S. Chemical Safety and Hazard Investigation Board, "Hazards of Nitrogen Asphyxiation", Safety Bulletin No. 2003-10-B, Jun. 2003.



CAROL suctions out material



ROBOTIC UNLOADING

The CAROL robot maneuvers inside vessels and suctions out material via its connection to a high-capacity vacuum. The robot is remotely controlled by a technician from the safety of a support trailer. Cameras and lights aboard the vehicle and mounted at the manway allow constant visual surveillance of operations.

The CAROL robot is an amphirol (screw-propelled vehicle) that is designed to sit on top of the catalyst as it vacuums material. A lightweight aluminum frame and large-diameter screws provide a buoyancy effect that helps keep the robot atop a full range of media encountered in catalyst unloading (densities from 40 - 80 lb/ft³ and particle sizes from 0 - 1 inch).

Twin worm gear propulsion powered by direct-drive hydraulic motors allows the robot to traverse semi-liquid substances. The vacuum head is connected to the robot by a hydraulic cylinder and can be raised and lowered remotely for optimum efficiency.

All in-vessel electrical equipment is rated for use in Zone 1 and Class 1 Division 2 hazardous areas (ATEX, IEC Ex and AEx certification on the camera system).

SAVINGS FROM ENHANCED PRODUCTIVITY

The CAROL system also increases catalyst removal efficiency, saves time and money compared to manual unloading, and accelerates reactor turnaround times.

A CAROL robot is capable of working at a constant rate around the clock, avoiding the downtime of shift changes, employee rotation and rest breaks associated with manual unloading.

In some applications, CAROL can be used simultaneously during gravity dumps or may enter the reactor while it is still at elevated temperatures to decrease catalyst removal time and standby.



Catalyst exiting continuous-operation knife gates on cyclone

CAROL ELIMINATES RISK OF MANNED ENTRY AND EXPEDITES REACTOR TURNAROUND TIMES