Reprinted from the November 2003 issue of BIC newsmagazine.

Stop – Don't weld to the shell!

Call ACS for a weld-less upgrade

Revamping a process vessel can be a costly undertaking. The internals are typically engineering intensive, and installation of a traditional welded approach is usually more expensive than the internals themselves.

One of the more interesting retrofit problems solved by ACS engineers involved a 122-inch ID vertical compressor suction drum in an offshore location.

Welding to the shell should only be undertaken after careful preparation of an ASME vessel. After performing hot work to the shell, re-certification of the vessel is required. This all costs time and labor — two commodities at a premium during a shut down.

Fortunately, ACS has been engineering and fabricating weld-less solutions for retrofits and upgrades for decades.

Many older vessels, such as decanters and knock out drums, were designed on the basis of gravity separation only, without the assistance of internals. This outdated approach results in overly large tanks and shells, which are costly both in terms of money and space requirements.

In past decades engineered internals have been developed to remove liquid droplets from a vapor stream — mist elimination — or to separate one immiscible liquid from another — coalescing. Retrofitting a vessel which previously had no internals (or supports) requires clever use of geometry and existing structures, as well as both conventional and proprietary internals and designs.

One-for-one replacements of existing coalescer or mist eliminator elements with higher capacity and/or efficiency units are the most common approach to increase capacity and do not require new housings or supports — just use of the existing supports.

Such replacements are straightforward. A wire mesh mist eliminator only handles one third to one half of the flow rate capacity of a conventional vane or "chevron." Fabricating the vane with the same critical dimensions as the mesh pad it is to replace ensures that it will fit in the existing housing. In summary, the capacity of the vessel is increased by simply substituting a higher capacity mist eliminator. See Fig. 1.

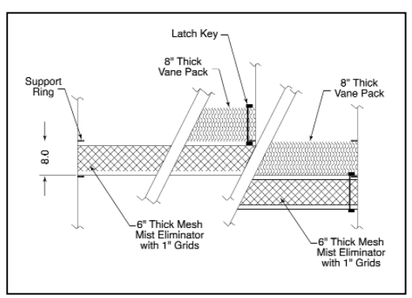

Fig. 3 Replacement of mesh pad with mesh-vane assembly of greater thickness than the original pad.

Vanes handle higher flow rates and are resistant to fouling but do not remove very small liquid droplets as do mesh pads.

In many refineries along the Gulf Coast and throughout the world, ACS has performed vane-for-mesh replacements in sulfur recovery unit (SRU) condensers.

In this application, small drops in temperature cause liquid sulfur to solidify quickly and plug mesh mist eliminators — a common occurrence during turnaround or process upsets. The low operating pressures at which the condensers operate, combined with the tendency of plugging, makes vane-for-mesh upgrades an extremely well suited solution.

Note also that head losses through vane units are considerably lower than through mesh mist eliminators — another benefit to SRU operators. Finally, the vane elements, if plugged, can be removed from the vessel and cleaned, a further benefit of the robust design.

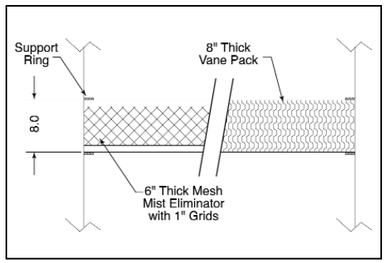

Fig. 1 One-for-one replacement of mesh mist eliminator with higher capacity mesh-vane assembly.

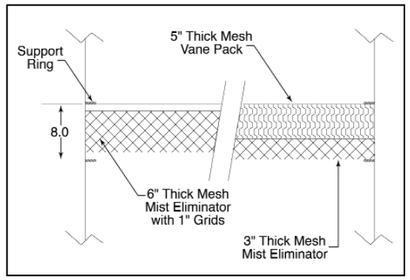

Fig. 2 One-for-one replacement of mesh mist eliminator with higher capacity and higher efficiency mesh-vane assembly.

In order to get the best of both worlds — the capacity of vanes with the removal efficiency of mesh pads — ACS offers mesh-vane assemblies as drop-in replacements of existing mesh pads. See Fig. 2.

The challenge is to make the new assembly with the same critical dimensions as the mesh pad it is to replace.

In the above examples, the vane or mesh-vane assembly can be fabricated to fit between two existing rings with 8-inch spacing. This is important because most mesh pads are secured in such configuration and spacing.

If the new process conditions dictate a solution of thickness greater than this, the existing rings can still be used by suspending the mesh from the lower ring or resting the vane atop the upper ring. See Fig. 3.

For absorption processes in which solvent losses are a concern, ACS routinely replaces 6-inch-thick wire mesh mist eliminators (8-inch total thickness including grids) with mesh-vane assemblies. In glycol dehydration for instance, the industry has moved away from using bubble cap trays and now uses higher capacity structured packing.

Unfortunately, wire mesh mist eliminators, which adequately remove glycol mist coming off the trays, perform poorly in packed columns due to higher vapor rates: the mist eliminators flood.

ACS has had considerable success retrofitting with mesh-vane assemblies (studies confirm reduction in glycol losses from 0.1 gal/mmscf to less than 0.001 gal/mmscf!). In many systems such as amine sweetening and glycol dehydration, ACS can offer process warranties on reduced carryover losses, which equates to solvent savings every hour of operation.

Often, and depending on the nature of the retrofit, new supports or housings are required. In weld-less solutions, these supports are attached to existing structures such as inlet baffles, flanges, etc. Weld-less solutions, with no shell welding and no vessel re-certification requirements, can include minor structural welding to non-pressure bearing vessel parts.

Welding to the shell would have required post weld inspection and re-certification delaying the shutdown by several more days.

In May, ACS received a call from a gas plant. Carryover from a 96-inch ID horizontal fuel gas suction Scrubber caused downstream damage and the plant shut down for inspection of the mist eliminator.

To everybody's surprise, no mist eliminator had been installed in the first place! Welding to the shell would have required post weld inspection and re-certification delaying the shutdown by several more days: a weld-less solution was needed.

The 30-plus-year-old carbon steel vessel had a 16-inch outlet nozzle of forged construction and heavy wall. From outside the vessel, a spool piece of pipe with diameter just less than the 16-inch outlet nozzle would be inserted. This spool piece would be suspended with a flange and gusset to support the weight. From inside the vessel, a slip-on plate flange was welded to the inserted end of the spool piece.

Each piece of the rectangular, inverted-hopper shaped housing was passed through the manway and assembled inside the vessel. The top of the housing was then bolted to the flange of the inserted spool piece. See Fig. 4.

This approach, using flanged spool piece and segmented housings, has been used in vertical drums as well. See Fig. 5.

The flanged spool piece approach is elegant and simple, but suspending considerable weight limits the range of services to which it can be applied.

A Texas refinery approached ACS with a 108-inch ID horizontal steam drum to be retrofitted with a mist eliminator. Ratings showed that considerable surface area was required. This could most easily be done with two large vanes (ACS PlatePaks®) in a V-bank configuration.

Housings such as this are typically seam-welded to the shell to prevent vapor by-pass. This large housing was not only of considerable weight but also created a long seam between the housing and shell that would normally be sealed with weld.

ACS designed a removable housing with two 7-foot-by-3-foot rectangular PlatePak vanes. The entire system was segmented for the manway. Scaffolding was used to mount the housing in place while expandable vertical post supports (jack-screw legs) were positioned to accept the load. When tightened in place, gasketing, instead of weld, sealed the interface between housing and shell. See Fig. 6.

One of the more interesting retrofit problems solved by ACS engineers involved a 122-inch ID vertical compressor suction drum in an offshore location. Vapor flow rates had been more than doubled. Liquid carryover in this application can quickly cause vibrations followed by mechanical damage as small droplets collide into and pit high-speed rotating equipment.

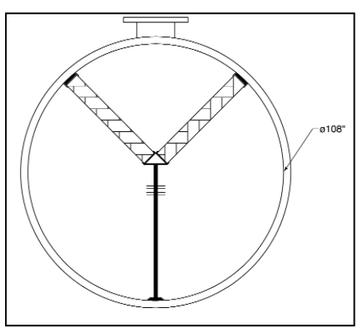

Fig. 6 V-Bank housing and mist eliminator in a horizontal vessel, supported with jack-screw legs.

The existing mist eliminator housing was a rectangular box welded to the top head. This was the only structure within the vessel to which a retrofit could be attached.

To accommodate the new flow rates, a four-bank housing of mesh-vane assemblies was designed. After first modifying the existing housing by cutting several pieces, a new housing was bolted to it. Stress analysis by ACS showed that the excessive weight of the four-bank housing could not be secured in place simply by suspending it. Therefore, the bottom of the housing was also supported from beneath with jack-screw leg supports.

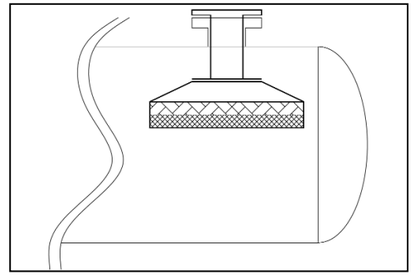

Fig. 4 Weld-less introduction of housing and mist eliminator into horizontal vessel, supported with flanged spool piece.

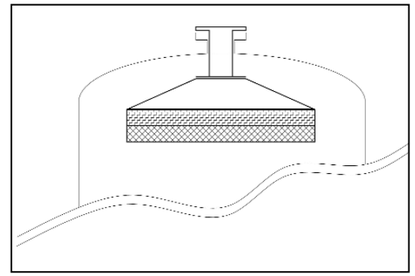

Fig. 5 Weld-less introduction of housing and mist eliminator into vertical vessel, supported with flanged spool piece.

The jack screw in turn rested upon an ACS AccuFlow™ Inlet Diffuser which was required for primary liquids removal and distribution of the vapor. In a new vessel or in a retrofit in which welding was allowed, a larger inlet nozzle would have been used.

Note that this inlet diffuser was in turn supported by two jack screws resting upon the bottom head of the shell. See Fig. 7.

Using jack-screws to friction fit a housing is relatively common in securing mist eliminator housings in drums and separators. For horizontal liquid-liquid coalescers, a similar approach is to use expandable and removable rings at the inlet and outlet sides of the element.

The ring is segmented for the manway and the ends of each segment are fitted with threaded hardware. This allows the ring sections to be assembled inside the vessel, positioned upright against the shell, and tightened into place. The ring also exhibits removable splices to allow the coalescer segments to be inserted between the rings.

This approach was recently used by ACS in the retrofit of an 84-inch inner diameter horizontal scrubber at a local ethylene plant. In this case the expandable rings were further secured with bolting to an existing inlet baffle, and a mesh-vane assembly handled more than twice the flow rate through the vessel.

The sample solutions briefly discussed by no means exhaust the approaches that ACS uses, but impart a general awareness of options available to planners. The costs of new capital equipment should be weighed against that of retrofitting an existing vessel in the traditional manner (with hot work), and with a weld-less solution from ACS.

ACS domestically engineers, fabricates and tests a broad range of tower and vessel internals including fractionation trays, packings and distributors, mist eliminators, coalescers, reactor internals, and installation hardware.

Located in Houston, just six miles south of the Astrodome and at the intersection of Almeda Road and the Sam Houston Beltway 8, junior engineers and turnaround staffs are encouraged to visit ACS' showroom, meet the team and audit the company's quality-oriented factory.

For more information, call (800) 231-0077 or visit www.acsind.com. ❑

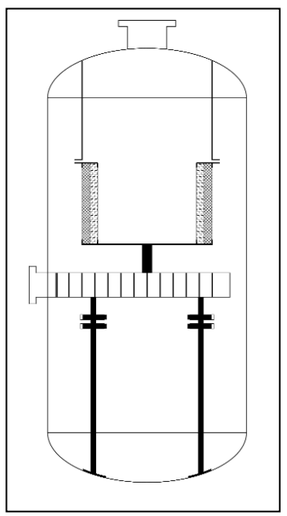

Fig. 7 4-Bank Housing, mist eliminator and inlet diffuser suspended from old mesh-pad housing and post supported with jack-screws.