Waterless Degreasing Platforms.

There are two aspects of heavy degreasing that should be appreciated: the dirtiness of the job and the time that it can take to degrease complex parts. In an industrial setting, it can prohibit a company from carrying out its operations in a timely fashion. To reduce human involvement in the degreasing process, many companies buy the strongest industrial degreaser which often contain toxic components. These toxic components often pose health hazards not only to the operator but to the environment. Chapter 2 Section 24, of the South African constitution requires the right to a healthy environment and the right to have the environment protected. However, degreasing a variety of parts in the timeliest fashion can depend as much what degreasing method you use as what kind of degreaser you use. One example of a degreasing method that allows companies to conduct thorough degreasing in a short amount of time is vapor degreasing, in which parts are placed in a special chamber that is designed to accommodate a special vapor degreaser.

Vapor degreasing is a no-touch degreasing method where the degreaser vaporizes within a vapor chamber, condensates on the parts to be cleaned, and eventually drips away from them, taking grease and a variety of other residues with it. Some companies choose to outfit their vapor degreasing systems with additional chambers where parts are sprayed with a solvent to speed up the degreasing process and rinse chambers to give degreased parts a post degreasing washing. But in any event, vapor degreasing offers companies several benefits in addition to reducing the time and effort of the degreasing process that other degreasing methods can't, such as offering the ideal solution for cleaning electronic parts.

One of the main drawbacks of aqueous degreasers is their tendency to leave dampness inside of electrical apparatuses, sabotaging electrical connections and causing parts to rust from the inside out. But in vapor degreasing, the degreaser condensates on the exterior of electrical parts and never invades their interior. Another advantage of vapor degreasers over traditional degreasers is that they offer a deeper level of degreasing. While all degreasers give parts a clean appearance, they often fail to completely remove grease and grime from tight creases and invisible pores. In most cases, small remnants of grease won't pose a problem. But if you plan on degreasing an object in order to paint, weld, solder or bond it, then minute amounts of grease can pose a problem.

A third advantage of vapor degreasers is that they leave no water spots and don't promote oxidization. Over the course of time, most water-based degreasers cause objects to oxidize, destroying both their appearance and eventually their durability. In addition, water-based degreasers have a habit of leaving water spots that can cause mechanized parts to wear unevenly. A fourth benefit of vapor degreasers is their comparative affordability. Because water based degreasers are either sprayed or applied liberally with a rag, much of their application ends up dripping away from the application site while taking little or no grease with it. But with vapor degreasers, not a single drop of degreaser is wasted. Finally water based systems eventually end up going to sewer where a number of compliance issues have to be overcome.

In vapour degreasing, the solvent which is contained in a specially designed tank is heated to its boiling point to produce a controlled solvent vapour zone. The article to be degreased is then mechanically immersed into this vapour zone, the vapour condensing on the metal surface. The condensed solvent runs off the metal, washing away the impurities. The metal dries when it reaches the temperature of the vapour. At this stage the clean article can be slowly removed from the tank.

The common type of solvent degreaser is the simple vapour machine. This may be combined with

immersion, where the article being degreased is immersed in the boiling solvent and rinsed with cool clean solvent, or spraying, where the solvent is forcefully sprayed on to the article. Some degreasers incorporate ultrasonics in their cleaning technique.

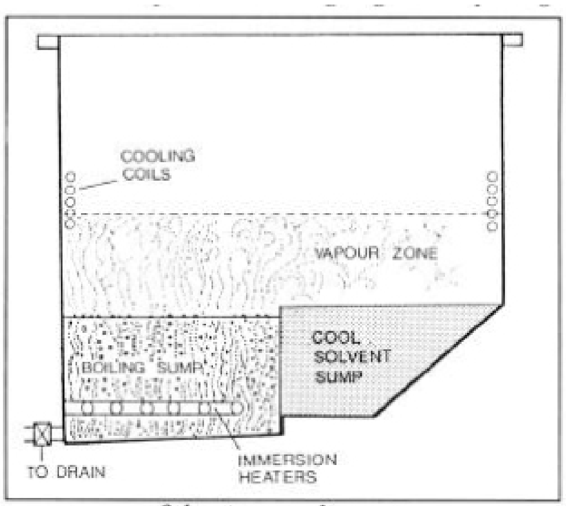
The acting principle behind the vapor degreaser process is that the solvents will dissolve the contaminants on the work-piece and remove them by dripping off the part. A sump containing the solvent is set up with a heating coil to bring the solvent to boil. As the solvent evaporates it rises to the fill-line in the chamber, above which is air with a much lower density than the solvent. A set of water cooled coils condense the vapour to prevent it from leaving the vessel. This contains the vaporized solvent in a closed space where the workpiece is placed. The solvent condenses on the more frigid workpiece and the now liquid solvent dissolves the greases on the part. With the impurities contained in the liquid beads, the solvent runs off the part. The OSS systems are designed to capture and reclaim this solvent, making the process much more economical.

Summary

- No touch system
- No Discharge of toxic chemicals to the sewer or discharge of emulsified hydrocarbons
- Total recovery of Hydrocarbons without contaminating them with degreaser chemistry
- A cleaner surface for subsequent operations such as welding, Painting etc
- No wasted solvent, all solvent re-useable and recoverable in one custom built unit
- No interaction between operator and cleaning medium
- No fugitive releases to the environment
- No compliance issues with water authorities

Design Considerations

All units are custom built to the individual companies requirements



Solvent vapour degreaser

Plant location

Air turbulence in the plant area can cause serious solvent losses. The features that create air currents, and thus disturb the vapour in degreasing units, include: doors, windows, heating and ventilation systems, and busy passages. Degreasers should be located away from any draughts and should be positioned in a no-smoking area. They should be isolated from naked flames, hot surfaces and welding operations. All solvent degreasers emit solvent vapour. Lip extraction may be used to eliminate exposure.

Cooling water supply

Anything which increases the movement of vapour from the vapour zone (VZ) into the freeboard zone (FBZ) will increase emissions and exposure to solvent vapour. Factors such as poor cooling and excessive heating can contribute significantly. The water-cooled condensing system is the primary means of containing solvent vapour within the degreasing plant. The correct flow of water through the system and the temperature of the water are of particular importance. If the outlet temperature is too high for the solvent in use, solvent vapours will not be effectively condensed and may escape from the top of the tank. If the outlet temperature is too low and below the dew point, water vapour will condense on the cooling coils and contaminate the solvent. The heating and cooling systems should be balanced in order to avoid overloading the cooling coils. If water is allowed to remain in the degreaser it can degrade the solvent and lead to corrosion problems.

The water outlet temperature will be influenced by the inlet temperature, which may vary throughout the year, and by the work throughput of the plant. The cooling coils should be kept clean to ensure continuing efficient heat transfer.

The adequacy of the cooling coils should be checked considering the solvent in use. In some cases additional cooling coils will be necessary and/or refrigerated cooling coils may be recommended.

Lids

Using lids is important, particularly when the plant is starting up, closing down or idling. Segmented lids are useful on long degreasing units, since they allow partial opening for degreasing smaller items. Sectional lids or roller shutters, where fitted, should only be opened as far as is needed for loading or unloading. Failure to use covers during work breaks will cause unnecessary evaporation of solvent.

Water separator

Water can enter a degreaser in a variety of ways. If allowed to remain, it can cause the solvent to degrade and can lead to corrosion. Water separators are normally fitted for the removal of excess water. For water separation to function correctly, it is vital that the gutters below the cooling coils do not overflow when the plant is running. Dirt and debris can build up in the solvent pipework and cause partial blockage, especially along the horizontal runs to the separator. If it is noticed that the gutters are tending to overflow, the pipework should be cleaned.

Support frames

Provision should be made for support frames within the condensation zone to support jig mounted components. This enables the lifting device to be removed and the lid closed over the work while degreasing is in progress. Frames also help to prevent damage to vulnerable parts of the plant such as the cooling coils.

Freeboard zone

Above the cooling coils is what is known as the freeboard zone (FBZ). There is always some movement of vapour from the vapour zone (VZ) into the FBZ and from the FBZ into the workroom owing to turbulent air diffusion. The rim ventilation is there to control the movement from the FBZ into the.

The freeboard ratio is defined as the freeboard height divided by the width of the open area of the tank. The higher this ratio, the less the chance of solvent leaving the plant and entering into the workplace atmosphere. A freeboard ratio of at least 0.75:1 and preferably 1:1 is recommended. A freeboard ratio of less than 0.75:1 is likely to lead to unnecessarily high operator exposure.

Rim ventilation (Lip extraction)

Leakage of vapour laden air from the FBZ into the work area is eliminated by lip extraction applied at the top of the tank usually down both the long sides but sometimes on all four sides. The lip extraction is a secondary, but nevertheless essential, control measure to prevent operator exposure and the escape of solvent vapour into the workroom. It is important to remember that the ventilation will control, rather than eliminate, vapour emissions. An extraction rate of 640-915 m3/hr per m2 of bath surface working area is recommended. For any degreaser with a specific rim vent design, extract fan specification and ductwork configuration, there will be a specific rim vent velocity. The degreaser supplier should provide the relevant figure.

Other extraction ventilation systems

Exhaust ventilation should be provided to remove solvent vapours from the load/unload zone of both multiple door degreasers and retrofitted enclosures on conventional open-topped degreasers. Exhaust ventilation should also be provided to remove vapours from the sludge door when this is opened, or from a pit in which a degreaser may be located.

Setting of safety devices

Safety devices such as sensors controlling sump level, sump temperature, top safety cut-out and bottom safety cut-out should be set correctly for the solvent in use. These should be checked regularly. Top safety cut-out is a temperature sensor fitted within the FBZ just above the cooling coils. Its function is to cut off the heat source to the degreaser if the hot vapour level rises too high, for example because the cooling water supply has not been turned on or is inadequate or fails. Bottom safety cut-out is a safety device which is set to limit the temperature of the solvent to prevent overheating and the risk of fire when the solvent becomes heavily contaminated with oil and grease. Some degreasers are additionally fitted with a low level cut-out device which is intended to prevent fire or damage to the plant. Where this is fitted, reliance should not be placed totally on it, and visual checks should still be made on the solvent level.

Solvent level

Maintaining the correct solvent level will help avoid solvent acidity, which can lead to corrosion of the plant, causing leaks or solvent decomposition giving rise to chemical reactions. In addition, if the solvent level falls too low on a heavily contaminated plant, there may be a risk that oils will ignite with further noxious fume emissions.

Solvent condition

Decomposition of the solvent can lead to acid conditions in a degreaser. This can lead to corrosion of the degreaser and possible solvent leaks. If aluminum or other light metal alloys are being cleaned, in extreme cases a rapid chemical reaction can occur, releasing hydrogen chloride. Warning of acid condition is sometimes given by the appearance of green corrosion deposits on the lower turns of the condensing coil. Decomposition can best be prevented by avoiding cross contamination of solvents, by preventing overheating, by keeping solvent levels topped up with fresh solvent and by regular cleaning out, particularly if light metal alloys are processed.

Correct stacking of hollow components

Hollow components or components with partial enclosed volumes (eg open tubing) require careful stacking or rotational jigs to facilitate draining; otherwise these will not drain properly and will still contain liquid when removed from the degreaser.

Drying time in the FBZ

Components should be allowed to hang dry in the FBZ of the degreaser until all residual solvent has evaporated (known as the dwell time). If there is no hoist or rest within the FBZ and the operator has to hold the basket manually, then dwell time is likely to be too short. A hook or fixture to facilitate this will be helpful and should be used.

Loading/unloading the plant at the correct speed

Loading work too quickly can create a piston effect, pushing solvent out of the degreaser, while withdrawing work too quickly can create excessive ‘drag out’. The need for a mechanical hoist to reduce manual handling and to reduce operator exposure during loading/ unloading should be considered. Where a hoist is used for loading and unloading, a maximum operating speed of three metres/minute in the vertical plane is recommended.

Workload

Loads should not exceed 50% of the open horizontal area at the plant. Consideration should be given to large components or baskets. Large area components or baskets may cause a pumping action, pushing vapour-laden air out of the FBZ. Large, vertically dimensioned articles may also cause bridging of the VZ and FBZ. Large components or baskets suspended in the FBZ and VZ at the same time may draw high concentrations of vapour into the FBZ.

Correct transfer of work between compartments in the plant

This should be done slowly and preferably below the vapour level. The work should be turned in the FBZ to minimise solvent drag-out.

Topping-up procedures

Fixed pipework should be connected to the sump for topping up with fresh solvent. This avoids operator exposure and possible spillages. If fresh solvent needs to be added, this should be done when the plant is cold, and the solvent should be piped in at a low level within the tank, with the cooling water system and rim ventilation operational. Poor practices such as pouring solvent into work cycle and in the operator's breathing zone, particularly during the highest emission phase of the work cycle. The highest breathing zone concentration probably occurs when work is taken out of the tank. These are not time-weighted values so there can be difficulties in relating the results to the OEL, but if used properly by trained and competent personnel, detector tubes can give a good indication of vapour-in-air levels and emission patterns.

Recommended Solvent type

This chlorinated solvent, Perchloroethylene(C_2Cl_4) suitably stabilized with a tough corrosion inhibitor, fulfills the requirements for many types of metal degreasing.

Advantages

Effective with Wet Metals—The high boiling point of this solvent (122°C/250°F) permits complete and thorough drying of the work by vaporizing moisture entrapped in porous metals, deeply recessed parts, and blind holes. This property is particularly advantageous where the presence of moisture may prove detrimental to the finish of the work.

Reduced Staining

Light-gauge metals may rapidly attain the vapor temperature of the lower boiling solvents before sufficient condensing action takes place to dissolve all the oil and rinse away the contaminants. The higher boiling point of perchloroethylene permits a longer and more thorough rinsing action and may reduce staining in cleaning operations employing vapor exposure only.

Removes Stubborn Soils—With its high boiling point, perchloroethylene is especially effective for removing high-melting pitches and waxes and for cleaning grossly contaminated parts.

Stability—Perchloroethylene shows little tendency to hydrolyze (degrade with water), but can decompose in the presence of strong ultraviolet light (e.g., from arc welding), releasing phosgene.

Decreased Corrosion

Perchloroethylene double stabilized contains an inhibitor system that provides extra corrosion protection for cleaned parts and the degreaser.

Vapor Recoverable by Carbon Adsorption

Perchloroethylene has had the longest and most successful experience with carbon adsorption recovery of all degreasing solvents.

Disadvantages

Longer Cooling Time

Because of the high temperature of parts emerging from the degreaser, more time must be allowed for the work to cool before it can be handled.

Heat Effects—Certain aircraft aluminum alloys are subject to structural change at temperatures near 122 centigrade, the boiling point of perchloroethylene. Also, printed circuit boards and plastic materials may warp or melt.

Health Hazards

When considering the hazards associated with any workplace, it is essential to understand the relationship between 'hazard', 'exposure' and 'risk'.

'Hazard' is the potential for an agent or process to do harm. 'Risk' is the likelihood that an agent will produce injury or disease under specified conditions.

Health effects can only occur if a worker is actually exposed to the hazard. The risk of injury or disease usually increases with the duration and frequency of exposure to the agent, and the intensity/concentration and toxicity of the agent.

Toxicity refers to the capacity of an agent to produce disease or injury. The evaluation of toxicity takes into account the route of exposure and the actual concentration of an agent in the body.

Exposure routes

The harmful effects of organic solvents follow inhalation of vapour, eye and skin contact with liquid or vapour, or ingestion, which are described below:

- *Inhalation* is the most significant route of entry by which harmful substances enter the human body at work.
- Toxic solvent vapours may have local effects, if they harm the part of the body they come in contact with. They may also have systemic effects, causing changes to the function of other organs.
- Some solvent vapours may be absorbed through the skin without any noticeable change to the skin, while others may cause serious damage to the skin itself.
- *Ingestion* is of relatively minor significance in occupational exposure to toxic materials.