BENEFITS

The IAS Solvent **Dissolution** of System **Fouling** & Solvent **Recovery** **(DFR)** Process delivers value:

Safer, Faster, Cost Effective

- **Non-detrimental** to equipment being cleaned
- **Longer runtime**, doesn't leave a carbonaceous residue like burnout typically will.
- **Less downtime,** doesn't require dismantling of the equipment
- **Easily applied,** circulated through process equipment,
  - on-site or off-site applications
  - with customers equipment and personnel or by customer's industrial cleaning services contractor
  - by use of auxiliary pumping/heating equipment
- **Solvent recovery** for reuse
  - on-site, during or after cleaning
  - off-site at a regional location or sent to a reclaimer
  - the dissolved polymeric fouling can be recovered neat for disposal
- **Non-toxic** and **non-hazardous** solvent
- **Technology support** via experienced chemical application and project managers as needed

FEATURES

The IAS DFR process dissolves polymeric fouling by contact with a very low vapor pressure, high flash point solvent. This unique non-toxic, non-hazardous solvent is easily heated and circulated through process equipment utilizing traditional chemical application techniques. This process has been proven effective on most olefinic polymers such as polybutadienes, polyethylene, polystyrene, latex, polypropylene, EPDM rubber, and various co-polymers.

The DFR process is proven technology that has been used numerous times on large heat exchangers to remove a diverse list of polymeric fouling. Solvent formulations have been, and continue to be, developed to remove polymeric fouling deposits that are not dissolved by traditional solvents. Effective solvents have been developed for almost all polymers encountered.

The DFR process is superior to labor intensive and potentially dangerous prior art mechanical means and furnace burnouts.

- IAS DFR eliminates the extreme stress on the metallurgy and the efficiency loss due to carbon deposits left by furnace burn-outs. Furnace burnout only cleans units in the furnace and does nothing for the rest of the system; IAS DFR cleans the whole system.
- IAS DFR also eliminates water blasting, which is often lengthy, expensive, messy, has significant safety risks, and often leaves a film of polymer. This compromises heat transfer efficiency and promotes polymeric fouling re-seeding.

The IAS DFR process includes a solvent recovery step that recovers solvent for reuse. This solvent recovery step is a vacuum adiabatic flash that separates the solvent/polymer solution into pure solvent and neat polymer.

Cleaning up to 625°F, 1,250°F with Vacuum Assist

Comprised of diphenylethane and alkylated aromatics, a high-temperature IAS solvent provides thorough removal of polymer residue such as varnish, as well as solid polymer materials from process equipment. Solvent is circulated through process equipment while equipment is in-line, dissolving residue and waste in reactors, heat exchangers, pumps, and pipes. Dissolved polymer is then flushed from system with solvent.

The IAS process is for cleaning olefinic polymeric fouling from surfaces of reactors, heat exchangers and other process equipment in which polymerized olefins are produced by solution polymerization processes. More specifically, the IAS process is a method whereby the polymeric fouling is dissolved into a high boiling, low vapor pressure aromatic hydrocarbon solvent and removed from the equipment to restore operating efficiency.

During the manufacture of olefinic polymers by solution polymerization such as, for example, polystyrene and the various copolymers of styrene and other olefinic monomers, finished polymer gradually builds up over a period of time on the surfaces of the process equipment where the material is produced reducing the efficiency of the reactions and ultimately requiring such polymer-fouled equipment to be removed from operation; and ultimately requiring that the equipment, under present practice, be transported to a specialized facility where the polymer is literally burned off of the fouled surfaces in specially-constructed furnaces to remove it. In order to transport such polymer-fouled equipment, environmental and safety requirements are such that, before leaving the plant gates, the polymer and equipment must be steamed to remove liquid solvents, usually the medium in which polymerization took place, which may be adhering to the surfaces of the contamination or the equipment itself. This operation occurs at a considerable expense and after the equipment is put back into service, it usually must be again removed for cleaning after an average of only about four months. Thus, it is an object of this process is to provide a turn-key solution, without downtime, whereby the surfaces of polymeric reactors and heat exchangers which become fouled and contaminated with olefinic polymer buildup can be cleaned without the necessity of transportation from the plant facility. It is also an object of this process to provide a polymer removal alternative to pyrolysis. It is a still further benefit of this process to lengthen the operation cycles of the equipment between cleaning. It is an additional objective of this process to provide a process whereby such reactor surface cleaning may be accomplished by dissolving the polymer in a solvent and removing it as a liquid from the reactor without dismantling equipment or transporting the equipment to off-site facilities. A still further object of this process is to provide a flexible process which allows IAS to remove poly-mer deposits from equipment surfaces at either an on-site or off-site location.

This process is successful for cleaning polymer process reactor vessels, lines, heat exchangers, pumps, pipes and other equipment negatively affected by polymer residue. The solvency properties of the IAS High Temperature Solvent enable thorough removal of polymer residue as well as solid polymer materials from process equipment without the physical labor used in traditional maintenance processes.

The IAS High Temperature Solvent is a mixture of diphenylethane and alkylated aromatics. The solvent is thermally stable at temperatures as high as 625°F and has a low vapor pressure. The IAS process is far more efficient than mechanical cleaning methods. Equipment can be cleaned in-line without disassembly, reducing downtime and labor requirements to deliver economic and health and safety benefits to users. The turn-key IAS process will allow cleaning operations to be conducted with greater frequency before equipment becomes completely fouled or is operating inefficiently.

Residue Forms During Polymer Processing

When polymers are manufactured, residue is produced during polymerization and monomer volatilization before the polymer is extruded into pellets. This residue can consist of plastic powder fouling that builds up inside secondary copolymer reactors and transfer lines.

As the residue builds up and solidifies on the internal surfaces of equipment, the reactors lose efficiency and must be cleared every three to six months, a difficult process requiring the reactors to be taken out of service for thorough mechanical cleaning. Mechanical cleaning is expensive and results in significant reactor downtime. Typically, cleaning includes "rodding out" heat exchanger tubes and sand blasting metal surfaces, a process that requires workers to enter the reactor vessels during the cleaning operation, which can be hazardous and cannot be attempted until after extensive flushing, testing, and re-checking has occurred. Ongoing monitoring of vessel conditions is also required during cleaning operations to ensure safety is maintained.

In some cases, a reactor chunking event can occur. Large-scale solid polymer is produced as a result of the aggregation of individual polymer powder particles as reactor temperature approaches the melting point of the polymer. This is a major failing event and requires extreme cleaning measures. Drills, chisels, axes and even chain saws may be employed to remove large polymer chunks, creating the potential for additional worker safety issues.

The IAS Process provides thorough cleaning at lower cost and can significantly reduce downtime and eliminate or reduce the need for workers to enter reactors. During cleaning, Specialized IAS High Temperature Solvent is circulated through process equipment while the equipment is inline. The powerful solvent dissolves polymer residue and waste in reactors, heat exchangers, pumps and pipes and the dissolved polymer is then flushed from the system with the solvent.

BOTTOM LINE SAVINGS & RESULTS

IAS applies new and innovative techniques in chemical cleaning applications, specifically:

- The removal of polymeric deposits, and
- The servicing of heat transfer fluid systems

These techniques provide safer, faster and more cost effective benefits to customers, including:

- Non-detrimental to equipment
- Longer runtime
- Less downtime
- Easy application techniques
- Solvent recovery for reuse
- Non-toxic and non-hazardous solvent
- Technology support

INDUSTRIAL ACTION SERVICES INCORPORATED
SPEED • PRECISION • RELIABILITY

Before Cleaning **After Cleaning**

POLYSTYRENE BUNDLE – before cleaning

Polystyrene Bundle

POLYSTYRENE BUNDLE – after cleaning

"STIRRED" POLYPROPYLENE REACTOR – before cleaning

"Stirred" Polypropylene Reactor

"STIRRED" POLYPROPYLENE REACTOR – after cleaning

Plugged Polyethylene Breaker Plate

Polyethylene Breaker Plate

After Cleaning

Safe - Fast - Economical - Longer Run Time