NALCO APEX PROGRAM

Sustainable Technology for Paint Detackification

Date of Nomination:	December 15, 2011
Primary Sponsor:	NALCO an ECOLAB Company
	NALCO Center
	Naperville, IL 60563
Contact Person:	Mr. Joseph P. Miknevich
	624 Hemlock Road
	Coraopolis, PA 15108
Email:	jmiknevich@nalco.com
Work Phone:	(724) 312-3717
Contributors:	Mr. David Scheimann
	Mr. Paul Balent

NALCO APEX™ PROGRAM

Sustainable technology for Paint Detackification

- APEX Milestone(s):

  Q4 - 2008
  Nalco Global Auto Team identifies need for New Innovation in Paint Detack – Key Initiative is to bring Sustainability to a hazardous product line

  Feb - 2009
  Successful formulation of a Sustainable Chemistry Trade Marked: APEX

  June 24, 2009
  APEX patent filed

  Aug – 2009
  First APEX Trials Start

  Dec – 2009
  APEX patent published
  APEX is commercialized

  Apr – 2010
  APEX is Launched Globally (Currently in use in 85 Assembly Plants)

  Oct – 2011
  APEX receives recognition by Tennessee Chamber of Commerce and Industry for Environmental Accomplishment

- The Nalco APEX Program (the nominated technology) is not eligible for the small business or academic awards.

- The Nalco APEX Program is nominated for consideration in the EPA Focus Area (3): "The design of greener chemicals".

- All research and development work as well as the manufacture and first commercialization for this product occurred in the United States.

- **Abstract:**

The APEX Program was developed to support an initiative in U.S. based manufacturing companies to create Green Waste Treatment Processes through innovations in paint detackification chemistry (and solids minimization chemistry in general). For the past

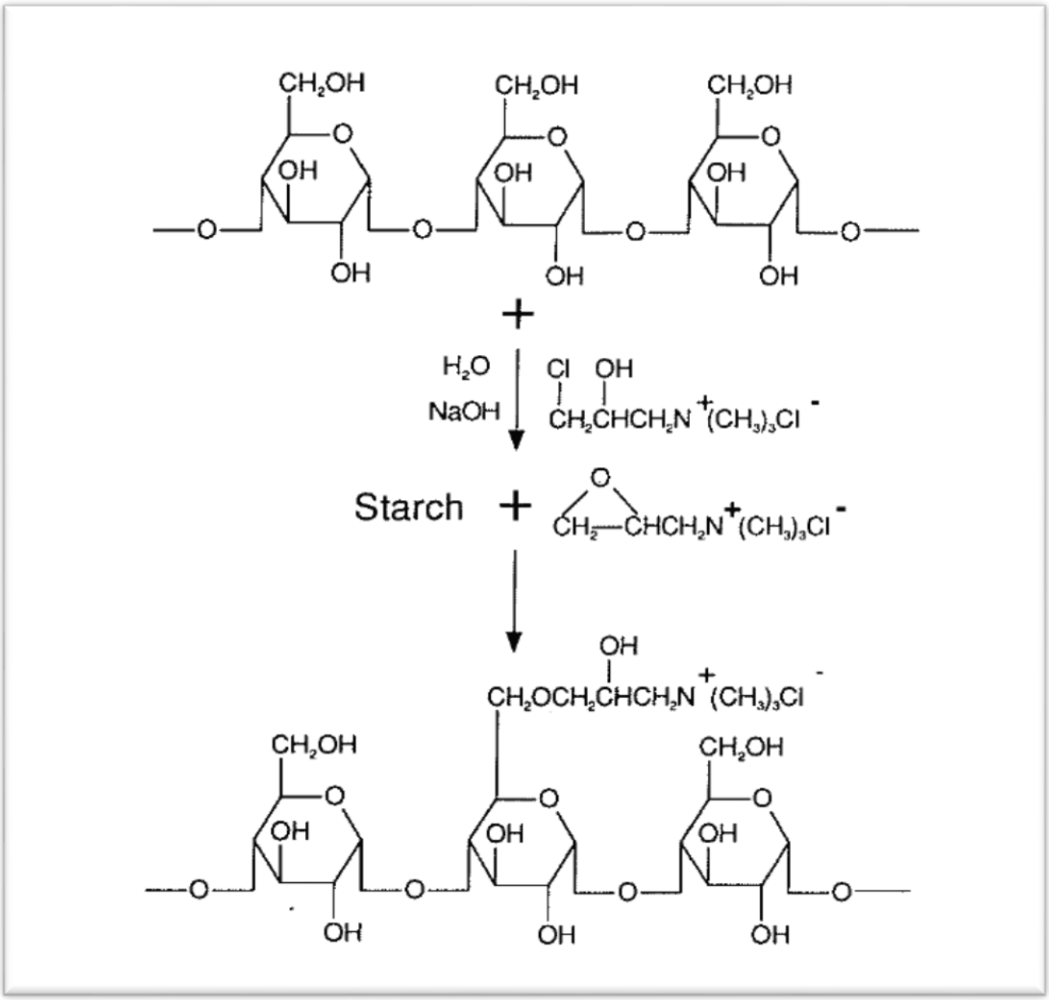
few decades, manufacturers have relied solely on hazardous chemistries containing melamine and formaldehyde to detackify paint overspray in their manufacturing processes. Understanding industry's desire to move towards more sustainable products, Nalco developed the APEX program which is formulated from over 99% sustainable resources (over 50% based on cationically modified corn starch). This program has completely eliminated the need for formaldehyde (and any other harmful/non-renewable raw materials) in these process applications.

In addition the APEX program has consistently provided the following benefits for every manufacturing company that has adopted this program:

1. Reduction in Total Cost of Operation (typically greater than 30%)
2. Reduction in Chemical Usage (typically greater than 80%)
3. Reduction in Waste Generation and Haul-off (Typically greater than 50%)
4. Reduction in Water Usage
5. Reduction in VOC

- **First Implementation:**
  APEX was first implemented at a large automotive plant located in Alabama. There APEX was able to reduce solid waste generation by 267,000lbs resulting in a $90,000 savings in disposal costs. It reduced VOC generation by over 3,000lbs (80% reduction). It also allowed for a reduction in booth cleaning frequency from weekly to once per quarter resulting in an additional savings of $160,000 in operating costs, along with a significant reduction in the chemicals used for cleaning. Because of the program's sustainable nature, and its ability to significantly impact other green efforts including water, waste, and VOC reduction....APEX is now recognized as the leading program in industry for Paint Detackification.

- **The Chemistry**
  APEX consists primarily of an etherified, cationically modified corn starch. (see diagram) This is mixed with a small amount of a proprietary amphoteric polymer and a polybasic aluminum salt. When added to a paint system at a pH >7.0 this generates a highly crosslinked "sweep floc" in situ that rapidly coagulates and detackifies paint solids generating a completely detackified, easily dewaterable sludge. The chemistry is innovative and has not been previously disclosed. Any of the individual components by themselves or any two of the three components are not effective in this application. It is only when all three components are present in the proper combination that the material demonstrates its effectiveness.



- **The Problem and Competitive Comparisons**

  For decades, Melamine Formaldehyde acid colloid has been known as the industry standard for paint detackification in paint spray booths. This material is derived from non-renewable petroleum or natural gas based feed stocks. It is provided as a dilute liquid in hydrochloric acid and methanol at a pH of 2 or less. Melamine is considered to be an eye, skin and respiratory irritant and chronic exposure may cause cancer or reproductive damage. Melamine has also developed a bad reputation as a toxic dopant added illegally to food products to apparently increase their protein content. Formaldehyde is classified as a known carcinogen by OSHA, the EPA, IARC and NIOSH. The warning signs posted with its use are the result of The Formaldehyde Act. Formaldehyde is on 8 regulatory lists and is ranked in the EPA's worst 10% list of chemicals for overall hazard to human health and overall environmental and ecosystem impact by an Environmental Defense Fund study. Formaldehyde is one of only a couple of dozen chemicals for which OSHA has mandated additional controls, monitoring and reporting.

Starting around 2008, OEMs made it known that they were concerned with its continued usage. To meet this need, many competitors have tried to find effective, sustainable alternatives to Melamine Formaldehyde. To date, none have been able to fully accomplish this. Many of these competitors have simply reformulated their melamine formaldehyde base component with different additives and branded their products as “green”. Others reworked old chemistry to include less than 1% renewable resources and launched marketing campaigns to tout the fact that they were now renewable and environmentally advantageous. Other programs developed rely on a methyl isobutyl carbinol based emulsion or replace the melamine with even more toxic aniline.

Nalco completely moved away from Melamine Formaldehyde in developing APEX with a focus on sustainable composition. As a result, APEX not only eliminated the need for Formaldehyde, it also is composed of over 99% sustainable resources. Considering this, APEX is the only program that meets the needs and expectations of OEM's for paint detackification. Once APEX was applied in a system it demonstrated several other significant improvements when compared to all competitive products. In every application, APEX achieved the following:

* Reduction in Total Cost of Operation - This has averaged 30% in comparison to all competitive products and is achieved through significant reductions in waste, chemical, cleanings

* Reduction in Chemical - The feed rate of APEX compared to Melamine Formaldehyde is a ratio of 1:6 – 1:10. This means that APEX allows for a significant reduction in chemical feed of over 80%. Reducing Chemical usage not only reduces costs, it also greatly impacts the environmental footprint for the OEM. Less chemical means less chemical deliveries (saves on transportation), less chemical inventory maintained on-site, and less solids added to the paint spray booth water (means less waste to be removed and disposed of).

* Reduction in Waste Haul-Off - accomplished by increasing %solids in waste sludge. APEX works much better at a much lower dosage than conventional programs and generates a more easily dewaterable sludge. As result, APEX is able to make waste sludge that has a solids concentration of 60-75%. Competitive products are only able to achieve solids concentrations of 30-40%. Higher %solids mean less water. As such, being able to make a more concentrated sludge means that less water is removed from the system, less water has to be removed by driers, and less water has to be hauled away with the sludge. Again, the use of APEX reduces the costs of removing waste sludge and

also reduces the environmental footprint for the plant (less waste, less water, less energy to run the driers, and less transportation to haul the sludge away).

* Reduced Booth Cleanings - APEX is more effective than competitive products in removing sludge and in handling changes in paint solids loading. As a result, the paint spray booths need far less cleaning to maintain the air flow necessary for efficient paint transfer efficiency.

APEX has proven in every application that it meets three critical criteria.....APEX reduces operating costs, APEX improves system performance, and APEX truly drives improved sustainability.

We have also included specific examples of how the APEX program is impacting U.S. Auto Manufacturers

Example #1

A large domestic automaker in Tennessee transitioned from using a Melamine Formaldehyde type detackifier to the APEX program and was able to document significant reductions in chemical usage and waste generation.

APEX Drives Reductions in Chemical Usage and Waste Generation in Tennessee

Measurement	Melamine Formaldehyde	APEX	% Improvement
Turbidity	224ntu	7ntu	96.9%
TSS	113ppm	18ppm	84.1%
Sludge solids	29.40%	49.50%	68.1%
Sludge Volume	12 hoppers (approx. 228,000lbs)	6 hoppers (approx. 113,500lbs)	50.0%
Daily Chemical Usage	214.3gal (1898.5lbs)	34.2gal (342.2lbs)	84.0%

Due to the success of the APEX program, the automaker was awarded the Tennessee Chamber of Commerce and Industry Award for Environmental Excellence in October of this year.

Example #2

At a green field automotive plant in Georgia a “Head to Head Trial” of APEX vs. other leading chemical programs was conducted. The results proved that APEX required significantly less volumes of chemical and provided higher levels of performance. This information was documented and published in a Nalco North American Case History File that can be provided upon request.

APEX Drives Reduced Chemical Usage and Improved Performance in a Head to Head Trial

Program Type	Paint System	Chemical Usage / Vehicle (gpu)		TSS (ntu)	Centrifuge % solids
		Detackifier	Flocculant		
APEX	Base	0.005	0.002	11	21-36
	Clear	0.01	0.001	17	17-31
	Prime	0.015	0.005	49	39-52
Chitosan	Base	0.038	0.005	31	19-23
	Clear	0.025	0.004	29	15-21*
Aniline Formaldehyde	Base	0.031	0.01	51	17-25
	Clear	0.03	0.008	23	21-28
	Prime	?	?	>100	?**

** Eliminated from trials due to fouling of centrifuge and screens*

*** Voluntarily withdrew from the trials after several performance issues caused operating concerns in the plant*

More examples and documentation of the APEX Program can be provided upon request.

- **Lifecycle Analysis**

  All feedstocks are inexpensive and readily available. Starch from a variety of sources can be easily modified to work. The manufacturing process is simple and robust requiring minimal specialized equipment. The product appears to have additional uses in paper, raw water clarification and emulsion breaking. There are no known disposal issues.

- **Summary**

  In closing, APEX was created with the intent of designing greener chemicals for a safer, more environmentally benign treatment program that would drive improvement in sustainability for industry. APEX has far exceeded any expectations that Nalco could have had in achieving these goals. The APEX program is formulated almost completely (over 99%) from sustainable resources, it eliminates the need for hazardous chemicals like formaldehyde, and it drives unprecedented levels of performance for industry. In every manufacturing plant that has transitioned to APEX, the program has been able to lower water consumption, lower energy consumption, lower waste generation, and lower operating costs.

  We hope that we have been able to articulate the green nature of APEX, the impact that it has had for U.S. manufacturing companies, and how innovative this program is in comparison to all competitive products.