RecycleSource™ Solution -

A new tool in the Green Chemistry toolbox
Applied to MPDSA

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PART I

ABOUT US

Why do we do what we do?

Newreka was founded in 1999 by a team of IIT-Bombay technocrats, passionate about nature and committed to environment. We believe that chemical industry has huge growth potential and for it to continue growing, it will have to grow in a sustainable manner in harmony with nature and respecting certain fundamentals of nature.

In the current reality of increasing population, growing demands, depleting natural resources **(especially water)**, increasing competition, increasing industrial emissions, stringent environmental discharge norms, etc, we believe that we need to reinvent how chemical manufacturing is done.

We believe that we need to reinvent how chemistry is done, reinvent how chemical processes are conducted, reinvent the kind of hardware that is used for industrial manufacturing, reinvent the way to look at and treat our wastes. Given the rate at which the population and our needs are growing and looking at the increasing frequency of natural disasters in the last decade, (a message from nature that our current practices are unsustainable) we believe that we do not have much time and this reinventing is urgent.

At Newreka, we are reinventing the way chemistry is being done conventionally and exploring the possibility of doing the same chemistry differently, in a more efficient, safer & more environment friendly manner. We are also reinventing the approach to deal with aqueous wastes streams coming out of various chemical processes; shifting from the conventional end-of-the-pipe treatment approach which is a "cost centric approach" to a "profit centric approach" i.e. how that aqueous waste stream could add value to our processes.

We also realize that real difference is made to the quality of environment when some Green Chemistry based innovation is implemented in the plant. Hence, our mission is "Pioneering & revolutionizing Industrialization of Green Chemistry & Engineering for environmental sustainability" and we are committed to focus on Industrialization of Green Chemistry based innovation in the chemical industry.

We serve the chemical industry by developing, customizing and commercializing Green Chemistry & Green Engineering based technologies & solutions to enable our customers in the industry to reduce their E-Factor (kg waste produced/kg product).

Who we are?

A group of nature enthusiasts came together for a tree plantation drive with the objective of making Mumbai cleaner and greener. After the tree plantation drive, few of those technocrats from IIT-Bombay, thought about creating a platform where they could serve the chemical industry to be more environment friendly. Thus, formally, Newreka was founded in 1999. The name "Newreka" is a combination of "Nature's Enthusiastic World **(NEW)**", the non-profit organization where the founders came together for tree plantation, and **"Eureka"**, the ancient Greek word to celebrate discovery.

Newreka's vision is to partner with Chemical Industry to design, develop and deliver Green Chemistry & Green Engineering based technologies & solutions to address their environmental challenges. Newreka also intends to develop powerful partnerships with all stakeholders of chemical industry to create an ecosystem for every chemist and chemical engineer to arise as an "Enviropreneur".

Newreka has diverse team of 60 + team members with varied qualification and experience. The team members are Bachelor's, Master's and Doctorate in Chemistry and Chemical Engineering from reputed institutes as IIT, ICT (formerly UDCT), etc.

Together as a team, we have competency in process innovation, process intensification, design and optimization of multiphase reactions, process scale-up calculations, implementation of technology at commercial level, setting up of recycle loops at plant, catalyst design and manufacturing.

From its modest beginnings, the company has now transformed into an award winning Enviropreneur. We have three functional R&D centers, which are designed to cater to various needs of our customers. At Newreka, customer's concerns and requirements are the top priority. Keeping that in mind, our R&D teams are strategically placed to enhance customer access. The R&D Centre at Dombivli, caters to customers based in Maharashtra, the Billimora Centre caters to customers based in Gujarat and the Solapur Centre services to customers from South India

What do we do?

We offer Green Chemistry based solutions that can be applicable to all chemistry intensive process industries like pharmaceutical, agro chemicals, dyes & pigments, other specialty & fine chemical industries.

We partner with our customers to reduce their E-Factor.

E-Factor or Environmental Impact Factor is defined as kg of waste generated per kg final product. A higher E-Factor means more waste and consequently greater negative environmental impact. *Hence, partnering with our customers to reduce their E-Factor involves us working together to reduce the environmental impact of their processes.*

Our special focus is in the Specialty & Fine Chemicals and Pharmaceutical Industries since these sectors have a very high E-factor of 50 to 100+.

These sectors of chemical industry have severe challenge of low process efficiency of chemical reactions. The poor selectivity leads to unwanted impurities and byproducts which lead to several steps of purification to get desired quality. This entire process leads to generation of tons of waste specifically liquid effluents and thus resulting in high E-Factor.

At Newreka, we are designing solutions that are economically competitive, practically implementable and reduce E-factor for chemical manufacturing industry.

We are open to partner with our customers in any of the following three ways:

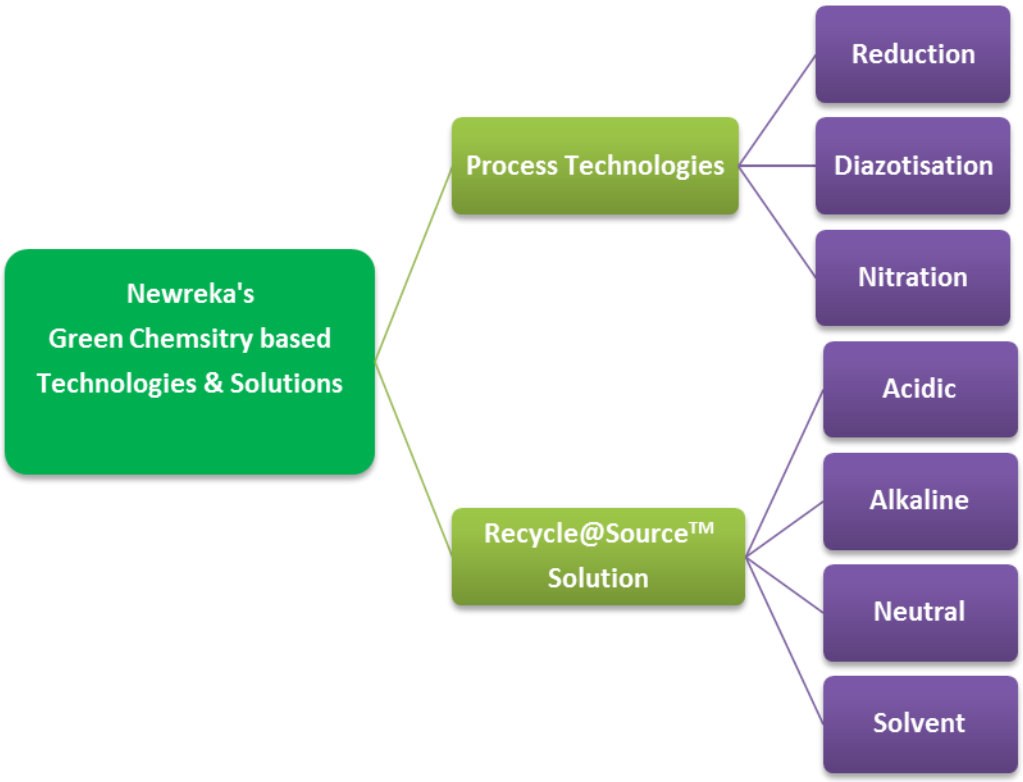
i. Making entire product/molecule's synthesis Green: This is a long term partnership with our customers where we look at each process step of their molecule and explore how efficiency could be improved & environmental load could be reduced so that the entire manufacturing process would be "Greener".

ii. Making Chemistry Green: This is a partnership with our customers where we work on a specific chemistry step e.g. Reduction, Diazotization-Hydrolysis, etc and explore possibilities of how the same chemistry can be done in a Greener way.

iii. Making Reaction & Extraction medium Green by Recycle@Source™ Solutions: This is a partnership with our customers where we work on an effluent stream generated from a specific process and explore the possibilities of recycling it back in to the same process as a reaction or extraction medium.

Our solutions can be broadly classified in to two categories:

1. Process Technologies
2. Recycle@Source™ Solutions



Process Technologies:

Newreka's process technologies are based on the principles of Green Chemistry and are alternatives to conventional ways of doing the same chemistry (synthetic chemistry based process). Our process technologies ensure high conversion, high selectivity leading to better yields and minimal waste. It also gives high throughput and are energy and environmentally efficient. Currently, Newreka's process technologies include solutions for reduction, nitration and diazotization-hydrolysis.

Recycle@Source™ Solution:

Recycle@Source™ Solution involves recycle of mother liquor/effluent stream (acidic, neutral, alkaline or solvent stream) generated from a particular process step back in to the same process as reaction or extraction medium.

Concept of Recycle@Source™ Solution

a. Reality of our processes & our plants

The manufacturing process in pharma, fine & specialty chemicals industry usually consists of a multi-step process. The number of chemistries involved in making a specific product, on an average could be anywhere between 3 and 9. Each step of these multistep syntheses uses 2 -3 raw materials, a reaction medium and an extraction medium to extract and isolate the product. At the end of that process step, it gives a finished product, and an effluent stream containing reaction and extraction medium, some by-products and some organic and inorganic impurities.

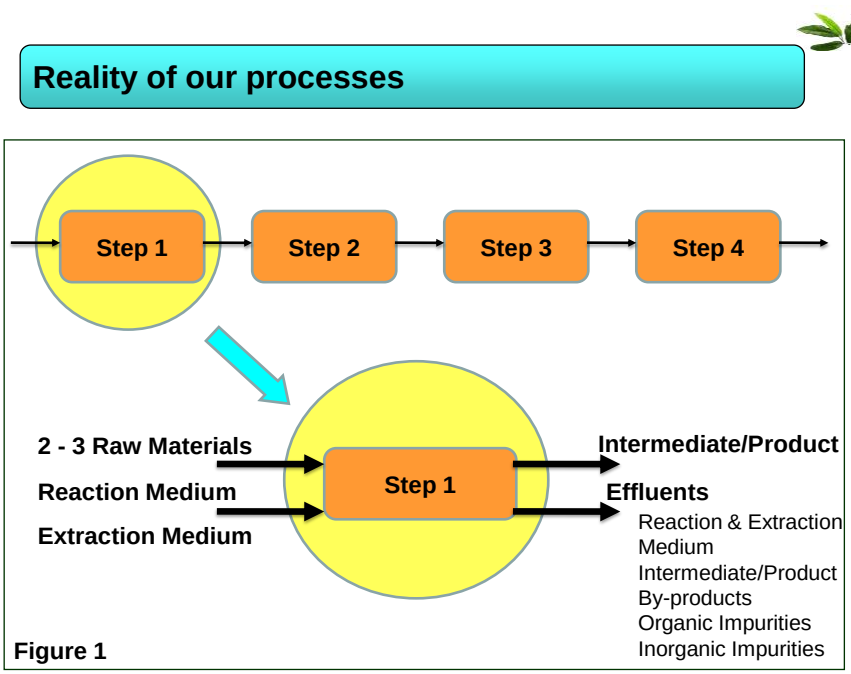


Figure 1

If we look more closely, we realize that the manufacturing of these complex molecules involves chemistry intensive processes and the yields of these processes are low due to low conversion, low selectivity and low separation efficiency. Also, since the pharmaceutical, fine & specialty chemicals industry is quality sensitive; it requires a lot of purification & washing of intermediates & finished product to achieve the stringent quality specifications. All these factors, lead to High E-Factor (E–factor is Environmental Impact Factor which is defined as quantity of waste generated per kg of product manufactured).

The effluent stream generated from each process step has its own characteristics and it varies from one effluent stream to another. It varies in terms of its physical properties like color, pH, temperature, etc. It varies in its chemical composition like concentration and type of organic and inorganic impurities. It varies in the volume generated. It also varies in its characteristics like COD, BOD, the total dissolved salts, ammonical nitrogen content, etc. Also, the toxicity and

hazard factor varies from one effluent to another. Finally what we have at the end of all these process steps is multiple effluent streams of all types of different quantities and characteristics.

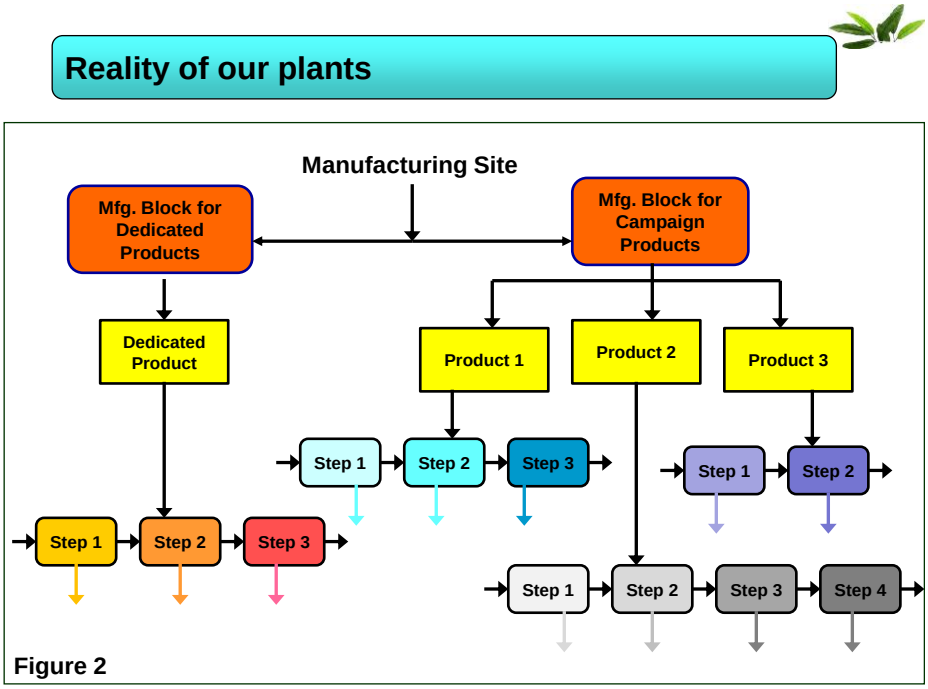


Figure 2

A typical manufacturing site of a pharmaceutical, fine & specialty chemicals manufacturing company usually has production multiple blocks, some dedicated to their regular products & some for their campaign based products. Each of these products would involve multiple process steps with different chemistries and the effluent generated after the end of each process step has at least 3 - 4 different chemicals.

b. Current Industrial Practice

The current industrial practice is to collect and mix all these effluents together so that the acidic streams partially neutralize the alkaline stream and hence the neutralization cost during primary treatment can be reduced. Mixing these effluent streams together creates a cocktail of 40 -50 different chemicals which is impossible to separate and impossible to recover any solvent, or product and impossible to recycle. Hence it is left with only one option that is to take it for some End-of-the-pipe treatments like aerobic or anaerobic treatment, biological treatment, biochemical treatment, incineration, etc.

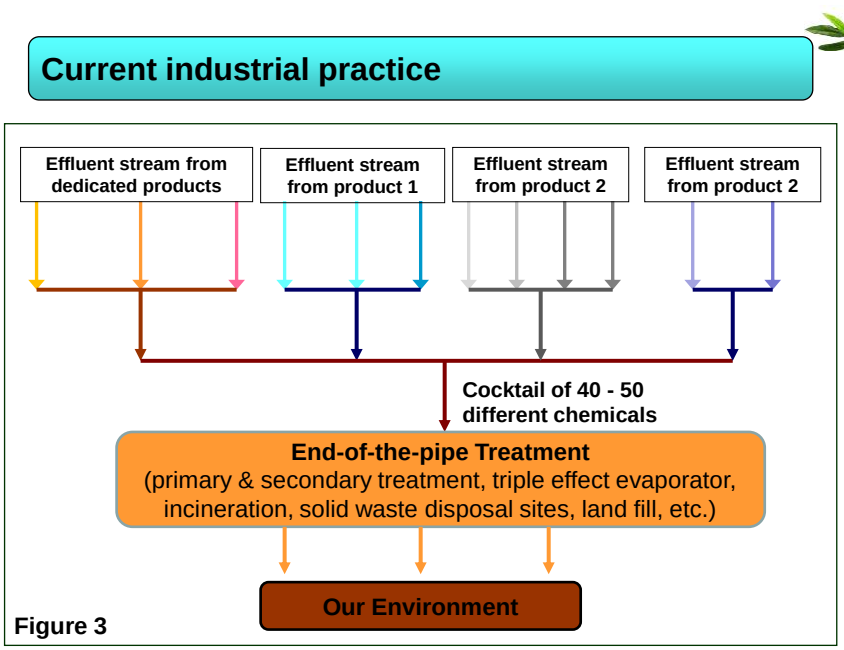


Figure 3

The key issue with end-of-the-pipe treatment is that it just converts one form of waste into another and most of the times we have very little or no idea about the ecological impact of these molecules (or the molecules formed during these treatments). Hence, this is a huge threat to human health, our water bodies and other living creatures. The second issue is that it is a cost-centric approach to deal with wastes and hence adds up to the cost of production. The third issue is that it is a tremendous waste of resources as the molecules on which we have invested material, energy, manpower, etc is being burnt away or disposed off.

Distinguishing Recycle@Source™

Sr.No.	***What it is Not***	***What it is***
1	Not remedial	It is Inherent
2	Not cost centric	It is profit centric
3	Not End of pipe solution	It is Systematic
4	Not Corrective	It is Preventive
5	Not Complex	It is Simple
6	Not Intricate	It is Integral
7	Not Multipart	It is In-built
8	Not Disposal related	It is Zero discharge
9	Not Recycle as secondary source	It is Cost effective, closed loop

Most of the times we come across literature which have word "Recycle" but have absolutely no relevance with the Recycle of reaction and Extraction medium. Essentially, in a nut shell, Recycle@Source™ means, **Inherent & Intrinsic Recycle of the liquid effluent stream, generated from a particular process, back in to the same process.**

c. How Recycle@Source™ Solution Works?

As discussed earlier in Figure 1, if we look at any process step in a multi-step syntheses, it will include 2 -3 raw materials, a reaction medium and an extraction medium. At the end of this process step, we get an intermediate or finished product and an effluent stream containing reaction medium and extraction medium, some by-products, and some organic and inorganic impurities.

Usually, the major component of the reaction mass is the reaction medium. On an average, raw materials and reagents contribute only 20% of the reaction mass. Balance 80% of the reaction mass is reaction medium, which finally after isolation of the intermediate/finished product is converted into liquid effluent. Hence, in most cases, whatever reaction or extraction medium we use, is what comes out (after intermediate/product isolation) as the key component of the effluent stream. E.g. if we are carrying out a diazotization-hydrolysis chemistry in dilute sulphuric acid medium, after intermediate/product isolation, in most cases, we generate dilute sulphuric acid containing effluent stream. Similarly, nitration chemistry would generate a nitric-sulphuric mixture containing effluent stream.

If the effluent stream generated is similar in its composition to the reaction or extraction medium, why not we recycle the same effluent stream back in the same process step as reaction/extraction medium? Currently, this cannot be done because if it is recycled, organic & inorganic impurities would build-up in the system and at some point will start affecting the purity of the intermediate/finished product.

In Recycle@Source™ Solutions, the effluent stream is treated with a customized proprietary performance additive (Recycle Cat, RCat), which selectively removes the organic and inorganic impurities to maximum possible extent (without removing the intermediate/finished product) so that the same stream can be recycled back into the same process step as reaction or extraction medium (hence it's called Recycle@Source™).

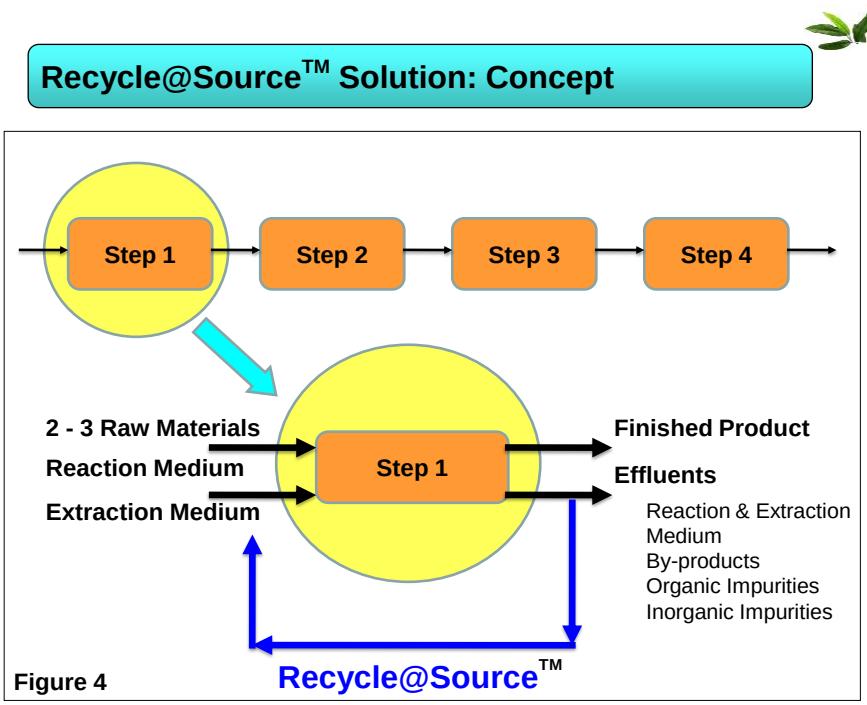


Figure 4

d. Advantages of Recycle@Source™ Solution

Recycle@Source™ enables the industry to:

i. Eliminate or minimize the liquid effluent load,
ii. Increases productivity (where effluent load handling is a limitation to expanding capacity),
iii. Enhances yield (as intermediate or finished product being lost in the aqueous effluent stream is recycled back),
iv. Consistent quality (RCat doesn't allow to impurity to build-up),
v. Improves overall economics, and
vi. Reduce the cost of effluent treatment & disposal.

e. Relevance to Indian Chemical Industry

For chemistry intensive chemical industry, Recycle@Source™ Solution is an immediately applicable, short term solution, without involving much capital investment. With existing hardware and new Recycle@Source™ Solution, the following objectives can be achieved with ease and convenience:

i. **Quality:** Consistent quality can be achieved not just after 5 recycles but in some cases even after infinite number of recycles, without any change in impurity profile. The color of the product, HPLC / GC purity and other quality parameter can be achieved consistently on commercial scale.

ii. **Quantity:** The essence of Recycle@Source™ Solution lies in enabling recycle of reaction medium and hence soluble losses of desired material can be brought back into system and practically theoretical yields can be achieved. Capturing additional 5 - 10 % losses of product gives cost advantage.

iii. **Productivity:** Cases where the production capacity of a plant is limited by the quantity of effluents that they are permitted to discharge, Recycle@Source™ Solution enables our customers to expand production.

iv. **Ease of operation:** Recycle@Source™ Solution involves two simple process steps and hence operation is very convenient for shop floor operators

v. **Safety, Hazard and Environment:** The Customized Recycle Catalytic Formulations (RCat) used in Recycle@Source™ Solution are safe, non-toxic and non-hazardous.

vi. **ETP and treatment cost:** With Recycle@Source™ Solution, the handling, storage and additional cost incurred in treating huge quantities of effluents is saved. This lowers the overall manufacturing cost.

Thus, Recycle@Source™ Solution addresses the triple bottom line of **profit, people and planet**.

f. Significance of Recycle@Source™ Solution:

With savings in effluent treatment cost, enhanced yields and higher production, Recycle@Source™ Solution gives overall higher profitability of 3 - 5% and breakeven on investment is achieved in 6 - 9 months. The current methods of disposal and effluent treatment are highly cost centric (both capital investment & recurring costs) with payback time of minimum 2 to 3 years. Hence, Recycle@Source™ Solution becomes a profit centric approach without incurring additional costs.

Some Credentials & Existing Customers

Newreka has a knowledge base of over **1,00,000** experiments conducted over the last decade by a dedicated team of **35** Green Chemists and Green Chemical Engineers. This team has already successfully delivered solutions to many of our customers across various industry sectors like API Intermediates, Dye Intermediates, Pigment Intermediates, and other Specialty & Fine Chemicals.

Following is the partial list of our clients with whom we are working:

Mylan Laboratories Ltd., Pidilite Industries Ltd., Lupin Ltd., Rakshit drugs Pvt. Ltd., Sajjan India Ltd., Sadhana Nitrochem Ltd., Chamunda Industries, Supriya Life Sciences Ltd., Bakul Pharma, etc.

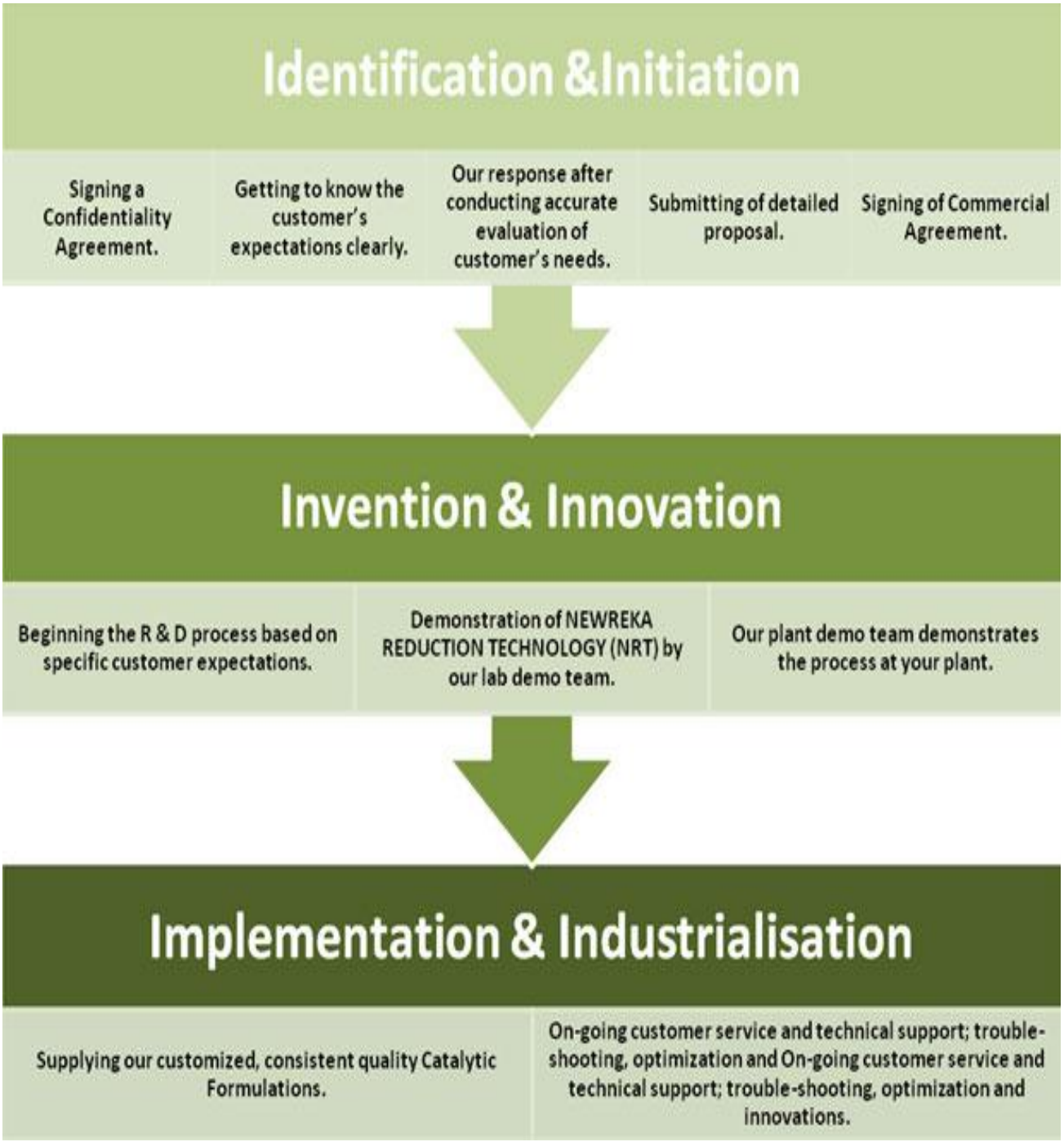
Newreka received the Indo-US GCNC award for Industrial application of Green Chemistry Solutions in 2008. We were nominated for Sustainability Award at Inform Ex2010, San Francisco, USA in 2010.

Newreka has filed 13 patents including 2 International patents. 2 patents have been granted so far and the rest are in various phases of process examination process.

Newreka and its activities have been extensively covered by a number of magazines. For eg. In June 2008, Specialty Chemicals Magazine carried an article called "Mother's little helper" stating that Newreka has pioneered green chemistry concepts in India. In November 2012, Specialty Chemicals Magazine carried an in-depth article about our Recycle@Source technology – "Recycle@Source: A new tool for green chemistry". We received extensive coverage in the June 2013 copy of Entrepreneur magazine. You can read the article here: http://entrepreneurindia.in/people/coverstory/the-real-green-shoots/19980/

How do we become partners?

Here is the business model we follow for partnering with our customers:



PART II

MPDSA

MPDSA (Meta Phenylene Diamine 4 Sulfonic Acid)

Meta Phenylene Diamine 4 Sulfonic Acid is s very important product in the dyestuff industry. It is used as a chemical intermediate for reactive dyestuff such as Reactive Yellow X-4G, Reactive Blue KE-R.

MPDSA Free Acid

Information regarding the molecule

Chemical formula - $C_6H_8N_2O_3S$

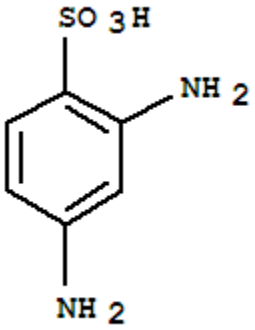
CAS number - 88-63-1

Molecular weight – 188

Synonyms

1,3 Diamino Benzene 4 Sulfonic Acid Free Acid
1,3 Di Amino Benzol, 6 – Sulphonic Acid
2,4 Di Amino Benzene 1 – Sulphonic Acid
Mataminic Acid

Chemical structure:



MPDSA Sodium Salt

Information regarding the molecule

Chemical formula - $C_6H_7N_2NaO_3S$

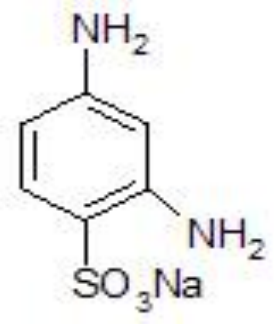
Molecular Weight – 210

CAS number - 3177-22-8

Synonyms

2,4-diaminobenzenesulfonicacid,monosodium salt
2,4-diamino benzenesulfonicacid,monosodium salt
2,4-diaminobenzenesulfonic acid,monosodium salt
2,4-diamino benzenesulfonic acid,monosodium salt
meta Phenylenediamine-4-Sulfonic Acid Sodium Salt
MPDSA-Na
Sodium 2-aminosulphanilate
Sodium 2,4-diaminobenzenesulfonate
(2,4-diaminophenyl) sulfonyloxysodium

Chemical structure



Newreka's Process

Newreka's patented technology uses the principles of green chemistry and helps in overcoming environmental challenges without compromising on the yields. It gives high throughput and since it produces minimal waste, it is energy and environmentally efficient.

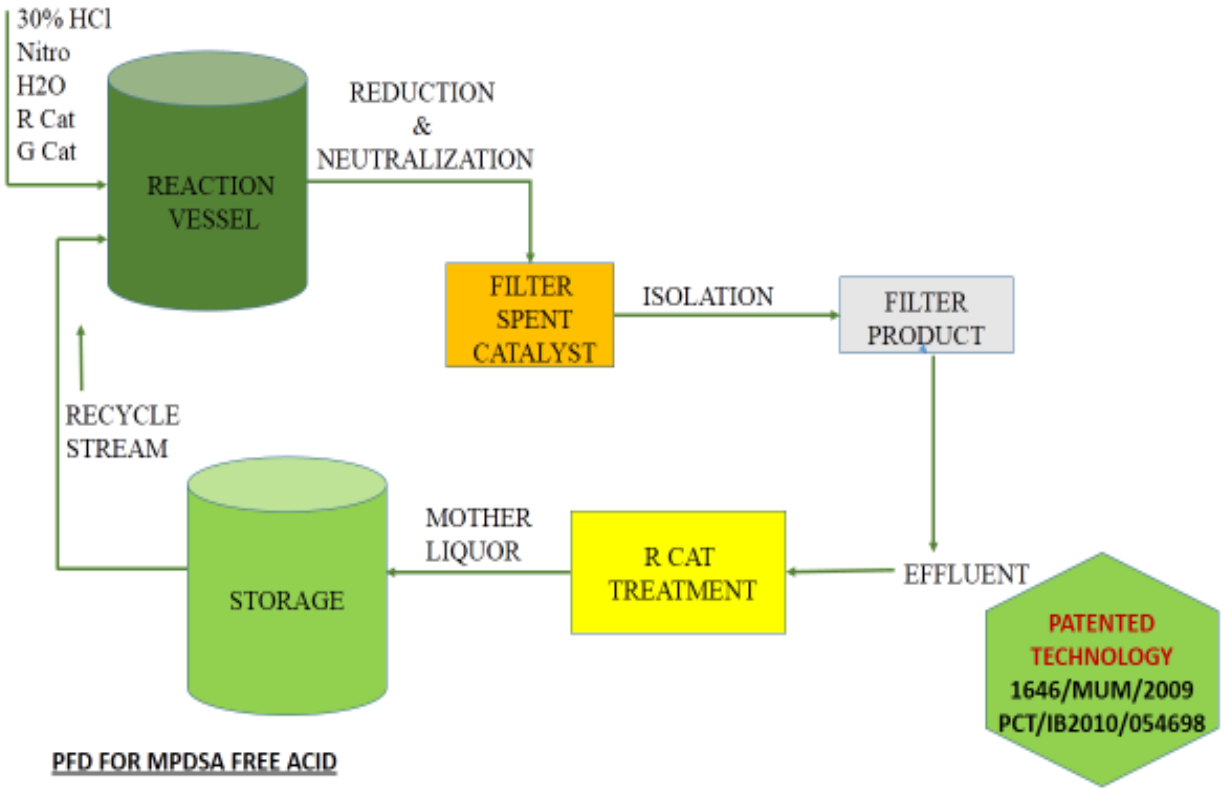
In Newreka's manufacturing process of MPDSA free acid, the nitro compound, 30% HCl, water, our proprietary catalyst "G-cat" react with each other and undergo reduction and neutralization. The spent catalyst is filtered and the product is later filtered and the effluent is treated with "R-Cat" and the mother liquor is sent for storage. As and when required, it can be recycled into the process.

Newreka's manufacturing process of MPDSA sodium salt is similar to the above process with the change being the addition of cast iron powder (CIP) to the reaction vessel.

The flow diagrams shown in the following pages illustrate these steps in the manufacture of MPDSA free acid and MPDSA sodium salt vividly.

The summary of the experiments carried out in our R&D laboratory for manufacture of MPDSA free acid and MPDSA sodium salt are shown with details of the startup, reduction, filtration, isolation, mass balance and the yield.

Newreka's manufacturing process for MPDSA free acid



MPDSA FREE ACID RECYCLE SUMMARY

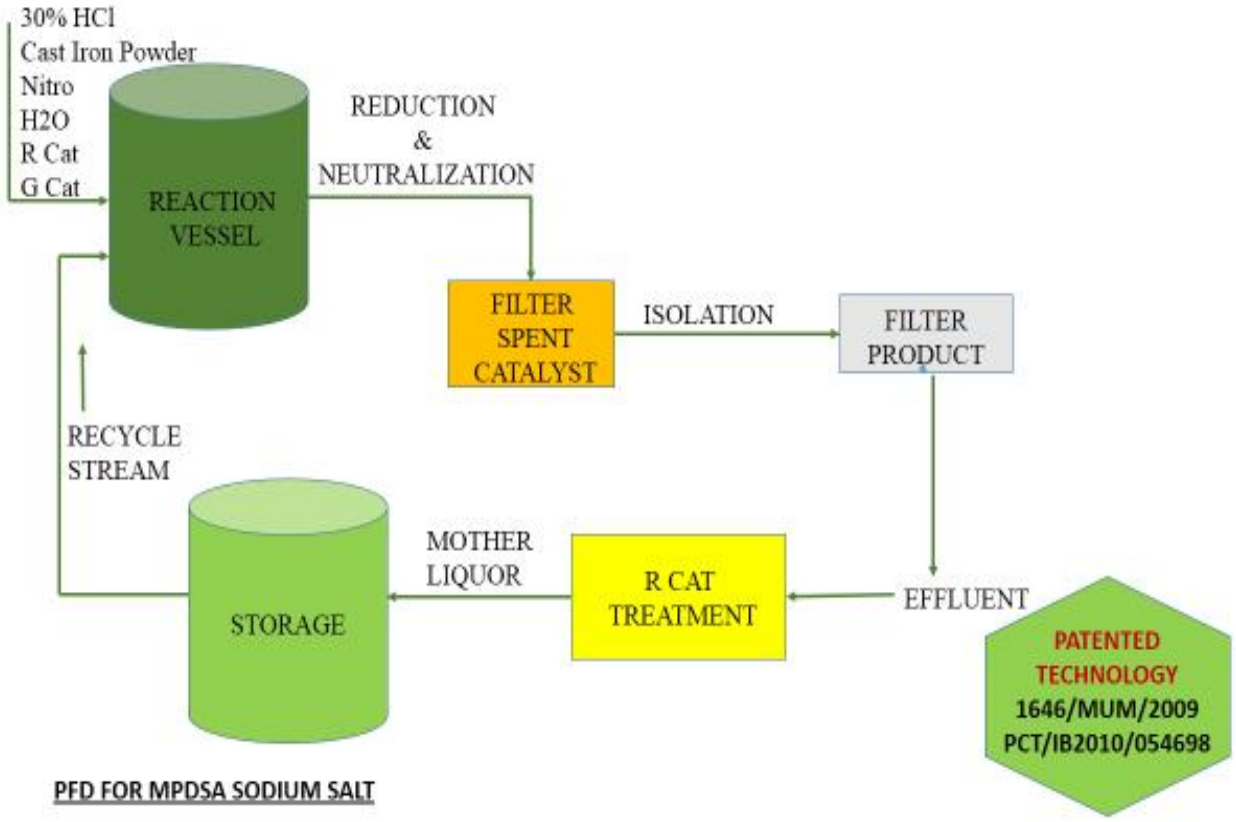
Nitro purity- 83.7 % **Colour- yellow** **PH - 8.0** **M/C- 10 %**

	UOM	FRESH	R-1	R-2	R-3	R-4	R-5
Batch No	#	06/10/0169	06/10/0172	06/10/0176	06/10/0181	06/10/0184	06/10/0188
Batch size	gm	50	50	50	50	50	50
St up Details							
Water/Re- ML	ml	200	200	200	200	200	200
HCL	ml	10	10	10	10	10	10
NRC	gm	21	21	21	21	21	21
During in Reduction							
Water/Re- ML	ml	100	100	100	100	100	100

NRC	gm	49	49	49	49	49	49
Nitro	gm	60	60	60	60	60	60
Red'PH		5.5-6.0	5.5-6.0	5.5-6.0	5.5-6.0	5.5-6.0	5.5-6.0
Red' Temp	"c	100	100	100	100	100	100
Reduction time	min	120	120	120	120	120	120
After Reduction							
NGC-HP 01	gm	5.1	5.2	5.3	5.3	5.3	5.4
PH		7	7	7	7	7	7
Filtration							
Filtrate	ml	220	230	240	240	260	280
Spent Wash ml	ml	100	100	100	100	100	100
Filtrate+wash ml	ml	320	330	340	340	360	380
% of Amine	%	11.5	13.12	13.23	13.23	13.05	1.15
gm of Amine	gm	35.4	43.3	45	45	47	50
Isolation Details							
Isolation ml	ml	320	32	340	340	360	380
30%H2SO4	ml	32	34	37	40	44	46
PH		2	2	2	2	2	2
Mother Liquor Details							
M L	ml	330	335	350	350	370	390
% of Amine	%	2.32	3.29	3.66	4.23	4.51	4.7
gm of Amine	gm	7.7	11.02	12.83	14.8	16.69	18.33
Spent Details							
Wet Wt	gm	122	137	140	137	140	130
Dry Wt	gm	101	112	105	103	102	102
M/c	%	17.21	18.24	25	24.81	27.14	21.53
%of Amine	%	0.47	0.37	0.47	0.94	0.94	0.94
gm of Amine	gm	0.47	0.42	0.52	0.96	0.96	0.96

Product Dry	**gm**	**28.2**	**31.4**	**31.4**	**31.5**	**30.5**	**32.2**
purity	**%**	**99.00**	**99.00**	**99.00**	**99.00**	**99.00**	**99.00**
Real Amine	**gm**	**27.91**	**31.08**	**31.08**	**31.18**	**30.19**	**31.87**
Yield	**%**	**0.56**	**0.62**	**0.62**	**0.62**	**0.6**	**0.63**
colour		off white	off white	off white	off white	off white	off white
Mass Balance	**%**	**100**	**100**	**98**	**99**	**97**	**99**
R cat tretment							
Temp	"c	40	40	40	40	40	40
Time	min	30	30	30	30	30	30
Rcat Qty.	gm	4	4	4	4	4	4
Tds	%	16	16	21	25	24	24

Newreka's manufacturing process for MPDSA sodium salt



PFD FOR MPDSA SODIUM SALT

MPDSA Sodium Salt Recycle Summary

Batch Size Real	gm	80	80	80	80	80	80
Fresh /Recycle	Rn	R0	R1	R2	R3	R4	R5
Input							
As Is Nitro	gm	100	100	100	100	100	100
Water / ml	ml	300	300	300	300	300	**300**
Spent wash	ml	80	80	80	80	80	80
HCL	ml	10	10	10	14	10	10
CIP 80%	gm	96	96	96	96	96	96

G-CAT 20%	gm	24	24	24	24	24	24
c.f		1.5	1.5	1.5	1.5	1.5	1.5
NGC	gm	9	10	10	12	15	15
R-CAT	gm	2.5	2.5	2.5	2.5	2.5	2.5
Nacl	gm	60	0	20	20	7	14
Be		13/23	23	23.5	24	23.5	24

Process parameter

Reduction Time	min	75	75	75	75	75	75
Filtration Time	min	5	5	5	5	5	5

Isolation vol.	ml	340	330	330	330	330	330
Maintain	min	60	60	60	60	60	60

MPDSA wet cake	gm	61	68	71	75	65	70.8
C.V	%	73.04	73.21	73.13	72	73.32	73.12
Real Amine	gm	44.55	49.78	51.92	54	47.65	51.68
Colour		off white	off white	off white	off white	off white	off white
Yield	%	0.56	0.62	0.65	0.67	0.6	0.65

Spent wet cake	gm	185	197	195	200	198	197
% of Amine	%	0.2	0.34	0.36	0.38	0.34	0.38
Real Amine	gm	0.37	0.68	0.7	0.76	0.68	0.75

Mother Liquor	ml	290	300	300	275	290	290
% OF Amine	%	2.97	3.5	3.6	2.97	3.73	2.58
Real Amine	gm	8.6	10.5	10.8	8.16	10.84	7.5
TDS	%	12	27	27	27.3	26	27.8

Rcat	gm	2.5	2.5	2.5	2.5	2.5	2.5
ph	ph	7	7	7	7	7	7
MB	%	96	95	96	95	93	92

ANNEXURE I

Green ChemisTree Foundation

In 2009, the founders of Newreka launched "Green ChemisTree Foundation", a not-for-profit organization to bring forth technical know-how regarding green chemistry and engineering applications amongst the Chemical community including Industry, Academia, Research Institutes, Govt. bodies, and Students.

This foundation aims to generate awareness regarding the potential of Green Chemistry to offer environmentally and economically feasible solutions to the challenges faced by the Chemical Industry and training, educating and sensitizing industry professionals, teachers, students about the same.

Another important activity carried out by this foundation is bridging the gap between Academia and Industry and bring about collaborations between them. To take this forward, the **Industrial Green Chemistry World (IGCW)** was launched in 2009. It is a biennial event and the 3rd IGCW is scheduled for 6, 7, 8 December 2013 at Renaissance Convention Centre, Powai, Mumbai. It includes:

IGCW Expo – a platform for companies offering green chemistry & green engineering based products, technologies and services to showcase their competency.

IGCW Symposium – Seminars and presentations from the founding fathers of Green Chemistry, networking with senior officials of environmental regulatory bodies

Conferences – For the pharma industry and the Polluction Control Board Officers

Workshop – Academia and Industry participation

IGCW Awards – Felicitate organizations that have used Green Chemistry principles/reduced waste/ produced safer chemicals, etc

For further details, please click on the following link: http://www.industrialgreenchem.com/index.html

ANNEXURE II

List of Newreka presentations and publications

- Presented in the 16th Annual Green Chemistry & Engineering Conference in Washington DC, under the theme 'Waste Valorization: Putting Waste to Work session'.

- Presented in the 16th Annual Green Chemistry & Engineering Conference in Washington DC under the theme 'Going Global: Green Chemistry in China and India session I'

- Presented in the 4th International IUPAC Conference on Green Chemistry at Brazil on "Recycle @ Source™ Solution as a technology in the Green Chemistry tool box for manufacturing chemistry intensive intermediates"

- Nitesh Mehta delivered a webinar to The Great Lakes Green Chemistry Network, USA, on the topic of "Recycle @ Source: An Effective Alternative to End of the Pipe Treatment"

- Mr. Nitesh Mehta presented a case study on the theme of Green Technology at India Chem 2010.

- Ms. Krishna Dave delivered a presentation on "Biomimicry" at the Young Innovators Choice Competition (YICC 2011) in January 2011 at ICT, Mumbai.

- Mr. Nitesh Mehta presented a technical presentation on Green Chemistry to all the members of OPPI (Organisation of Pharmaceutical Producers of India).

- Dr. Komal Maheshwari delivered a presentation on "Recycle @ Source" at the YRC-YICC 2011

- Newreka participated in Informex 2011, which was held on 7 - 10 Feb 2011. Newreka participated in the Green Pavilion at the event and also sponsored the Green Chemistry Breakfast briefing at the show.

- Dr. Komal Maheshwari gave a presentation on "Sustainable Metal Catalysis: From Paradigm of Iron Metal", at the Department of Chemistry at the Institute of Chemical Technology (ICT), Mumbai, during seminar on "Green Chemistry and Catalysis" on 3 - 4 March 2011, at ICT, Mumbai.

- Mr. Nitesh Mehta presented a day long conference on "Green Chemistry for Environmentally Sustainable Manufacturing" to all BDMA (Bulk Drug Manufacturers Association) members at "Green Chemistry – An effective tool to achieve Economical &

Environmental Competitiveness", an event organized by the Andhra Pradesh Pollution Control Board (APPCB).

- Mr Nitesh Mehta presented a case study on "Recycle @ Source" for specialty and fine chemicals industry at the 'Green Chemistry & Engineering' seminar during Chemspec India 2011 on 14 Apr 2011.

- Mr. Nitesh Mehta presented a half day seminar on "Green Chemistry for Sustainable Manufacturing" which was organized by Naroda Industries Association on 29 Apr

- Mr. Nitesh Mehta made a presentation on "Industrial Green Chemistry - Challenges & Opportunities" at Chemspec Europe.

- Mr. Nitesh Mehta made a presentation on "Recycle @ Source - Concept and Case Studies" at Chemspec Europe.

- Mr. Nitesh Mehta presented a case study on 'Green Albendazole Synthesis' during a session at "The Greener Pharmaceutical Processes and Products", along with eminent speakers, like Dr. Peter Dunn from Pfizer, Dr. Neil Adlington from Astra Zeneca and Dr. Broxterman from Glaxo-Smithkline, at the 15th Annual Green Chemistry & Engineering Conference in Washington DC.

- Ms Krishna Dave shared a presentation on "Green Chemistry Initiatives in India" in the Education and Outreach session at the 15th Annual Green Chemistry & Engineering conference in Washington DC.

- Mr. Nitesh Mehta chaired a session on "Entrepreneurship" at the 15th Annual Green Chemistry & Engineering Conference.

- Mr Rajesh Moholkar presented an EHS meet of Zydus Cadilla Pharmaceuticals on "Green Chemistry: It's Need of Hour" in June 2011 at Ahmedabad.

Publications in Media and Trade Magazines:

- Newreka got mentioned in IHS- Chemical Week.
- Contributed an article in Water Today Magazine on Recycle @ Source technologies
- Contributed an article in Speciality and Fine chem., an International trade magazine