

# Initial Study of a new environmental protecting resin for making toner

Wang yong (Tian jin shi hai he hospital); Tian jin shi. China

## Abstract:

Toner is one of main consume materials of the printer and copier. It was used 1.04 ten thousand tons at domestic in 2006 and It is increasing 5%-10% each year. Its majority ingredient is 40%-70% adhesive resin .Styrene and acrylic acid resin is more than 60% in total toner. About several thousand tons of styrene is expend every year .There are two aspect pollution of environment .One is styrene and ethyl benzene .The other is 5%-10% waste toner .We can smell irritating aromatic of styrene and ethyl benzene especially bad toner in air .It can cause people psychasthenia following headache , debility , nausea etc long-term working under this condition .It is very difficult to get rid of styrene and ethyl benzene from resin. In order to decrease environmental pollution of styrene and ethyl benzene etc. and ensure people health , The resin of toner was prepared by first using a new safe environmental protecting limonene replacing the styrene .Experiments showed that its glass temperature, soft temperature is near to styrene-acrylic resin .

**Key words:** Toner Environmental protecting Styrene Limonene

## Background:

More and more toner was used in daily life as fast developing of office equipments. E.g. printer. Copier. It was consumed 1.04 ten thousand tons at domestic in 2006 and It is increasing 5%-10% every year reported by CCIA. Toner is made of adhesive resin that is approximately 40%-70%. Type of styrene and acrylic acid resin is more than 60% in total resin. [1] About several thousand tons of styrene is used to synthesize adhesive resins every year. Because much of benzene vinyl was used for making resin, Poison among resin polluted environment and harmed people health that operate the machine. There are two main pollutions. One is 1% residual ethyl benzene that is from ethyl benzene clearage to produce benzene vinyl. [2] and unpolyerization benzene vinyl monomer. [7] The other is 5%-10% waster toner.

.We can smell irritating aromatic of styrene and ethyl benzene especially bad toner in air, when copiers or printers are running. It can cause people psychasthenia, following headache, debility, nausea etc, long-term working under this condition. .It is very difficult to get rid of residual styrene vinyl and ethyl benzene from among toner resin. «Circulation economy law» was issued by State Environmental Protection Administration claimed to obtain the most economic and social effects by means of the minimum environmental pollution. [3] For this reason it is completely necessary and significant to search a kind of monomer that is friendly to environmental and harmless people to substitute styrene vinyl for making resin of toner. In order to decrease environmental pollution of styrene vinyl and ethyl benzene and ensure people health, we chased the limonene that is extractive of

tangerine pericarp.It is a new type, natural, and environmental protecting material. Its chemical structure is very similar to styrene vinyl. Its chemical name is 1-methyl-4 isopropyl cyclohexene. Molecular formula is C<sub>10</sub>H<sub>16</sub>. Molecular weight is 136.23. It is appearance colorless liquid with a sweet-smelling of orange. It is being utilized in domain of chemical engineering, medicine, environment and foods. [4] We had initially made a new resin of toner in the world by first using a new safe environmental protecting monomer limonene that replacing the styrene .Experiments showed that its glass temperature, soft temperature is near to styrene-acrylic resin.

We believe that it is possible for replacing styrene vinyl with limonene by further study.

## Experimental

### 1. Microwave solvent extraction limonene

The solvent of microwave aid extraction limonene is a strengthening extraction method. [6] The skin of fruit leavings is first breaked into pieces by pulverize. Then extracting agent was poured into it. The limonene is extracted in pipeline reactor under microwave exposure. It was separated after residual body and organic phase was filtered. Residual body was distilled to collect organic solvent that returns periodic duty. There are main orange oil and extraction solvent in organic phase. The limonene is fast gained by reduced pressure distillation. Technology flow chart sees Fig.1.

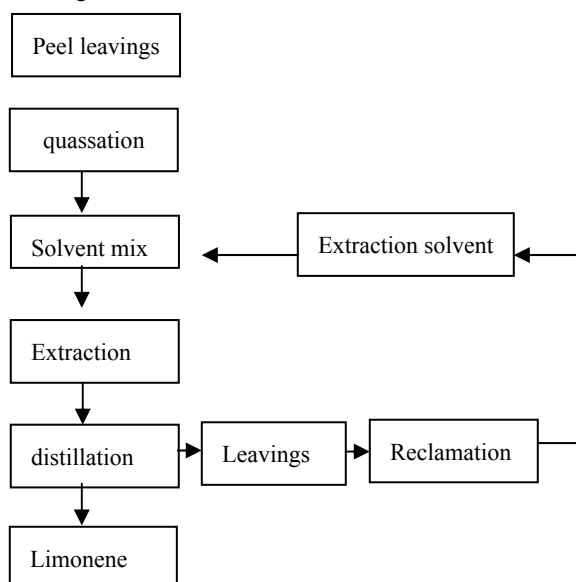


Fig.1.The limonene process extraction flow chart [5]

## 2. Resin synthesis

### 2. 1 Principal agents and instruments

Benzene vinyl, Butylacrylate (Tian Jin chemical plant. China. CP) Inhibitor must be removed before it was used. Limonene. (CP)

2, 2,-azobisisobutyronitrile (Su Zhou a li chemical plant. China. CP)

Z-93-Electric agitator. Jy88- ii ultraphonic scatter meter. Sy21-Ni Electric heat thermostatic water bath. DSC-55 Thermal analyzer. FLR-10 Flow test and measurement meter.

### 2.2 Polymerization process and results

#### (1) Benzene vinyl and butylacrylate resin preparation

First benzene vinyl and butylacrylate according a certainly ratio are put into three-mouth bottle, then adding initiator of 2, 2,-azobisisobutyronitrile. Agitate speed; reaction temperature and time were controlled in synthesis reaction process. Glass temperature (Tg) and softening temperature (Ts) of products were measured after reaction was over.

#### (2) Limonene and butylacrylate resin preparation

First limonene and butylacrylate according a certainly ratio are put into three-mouth bottle, then adding initiator of 2, 2,-azobisisobutyronitrile. Agitate speed; reaction temperature and time were controlled in synthesis reaction process. Glass temperature (Tg) and softening temperature (Ts) of products were measured after reaction was over .Results see Fig.2

Monomers	Benzene vinyl : Butylacrylate		
ratio	4:1	5:1	6:1
Tg (°C)	55	61	65
Ts (°C)	112	120	130
Monomers	Limonene : Butylacrylate		
ratio	4:1	5:1	6:1
Tg (°C)	53	62	66
Ts (°C)	110	115	122

Fig.2.Different monomers ratio of resin thermodynamics performance

## 3. Results and discussion

Tg and Ts are bis-significance index of resin for making toner.

It determined toner qualities. E.g. Toner's elaborate performance, Toner's fixing temperature, Copy's Imagery quality. Toner's storage stability. Etc. Tg or Ts numerical value are very near indicated from Fig.2 between resins of Benzene vinyl reacting with Butylacrylate and Limonene reacting with Butylacrylate. Every body knows that glass temperature or softing temperature of linetype non-crystalline state polymer is temperature which its physics state beginning change at invariably press and rising temperature speed. Tg is a temperature that polymer segmer is beginning to move. Ts is a temperature that polymer is beginning to viscous flowing. There are two chief factors that affect polymer thermodynamics behavior, one is molecular mass of polymer, and the other is chemical structure of polymer. Monomers structure and mass see Fig.3.

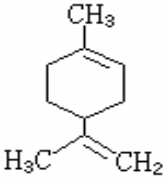
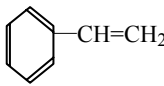
Limonene structure formula and molecular mass	Benzene vinyl structure formula and molecular mass
 <p>136</p>	 <p>104</p>

Fig.3 Limonene and Benzene vinyl's chemical structure and molecular mass.

Theirs chemical structure and molecular mass are near between limonene and benzene vinyl indicated from Fig.3. Benzene ring is stabilization than hexa-carbocycle including one double bond. Energy making their molecular movement is near, because limonene is two methyl more than benzene vinyl. It is very possible that limonene take the place of benzene vinyl for making resin of toner from our initial experiments. We shall do other experiments about resin's electricity performance, matching with others material, stability etc, in the future.

## 4. Conclusions

Social need of toner is becoming increasingly more and more. Environmental protecting is very important to every one. Our goal is not only to ensure toner quality but also not to pollute environment and to use safety. There are a lot of orange leavings in the world. Limonene is a sort of natural, green, reliable material. We believe that limonene can substitute benzene vinyl for making toner.

## References.

- [1] Zhao Yao hong. Han jian. Toner with resin. [J] Office equipment technology. 2003.3
- [2] Xu zhi gang. Qian zhi yi. Yu feng. New reactor for

methylbenzene dehydrogenation to styrene. [J] Chemical world. 2004. 1

[3] Wang li qun. Superficial chat circulating utilization and environment protection project of office equipment. [J] Office equipment technology. 2004.3

[4] Wang wei jiang. Study advancement of limonene, natural activity monoterpene. [J] China food additive. 2005.1. 33—37

[5] Xu gang. Liu hai han. Extraction and application of orange oil from the orange residues. China technology paper on line. [Http//www. Paper. Edu. Cn](http://www.Paper.Edu.Cn).

[6] China-south university. Extraction of orange oil and pectic from orange residues. [P] China. 200510032262.7

Matthews R F, Braddock R J. Recover and application of essential oils from oranges. [J] Food technology. 1987.41(1) 57-61

[7] Meng xiu qin. Leng xin xin. Noxious substance are measured when copier or LaserJet are running. [J] Office equipment technology. 2004.3