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Green chemistry – A new branch of Chemistry for organic product synthesis

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Abstract: - A new field of chemistry is rapidly emerging called "Green chemistry". With the utilization of maximum possible resources in such a way that there is negligible or minimum production of hazardous chemical waste. As we can easily synthesize the derivatives of acelanilyde(compounds I-IV) . So this new synthesis process is better than old conventional process. By using this process we can not only able to avoid the use of acetic anhydride (a hazardous compound) but also the formation of other hazardous products. It was found that 72% to 82% of molecular weight of product can be synthesized by this process.

Key words: Green synthesis, green chemistry, acetanilide, atom economy

I. INTRODUCTION[1,2]

In these days a new branch of chemistry is rapidly emerging called "Green chemistry" which involves pulling together tools , techniques and technologies . It is helpful to chemists and chemical engineers in research , development and production for development of more eco - friendly and efficient products which may also have significant financial benefits . It is now going to become an essential tool in the field of synthetic chemistry . The development of Green Chemistry redefines the role of a solvent : " An ideal solvent facilitates the mass transfer but does not dissolve " . In addition , a desirable green solvent should be natural , nontoxic , cheap and readily available with additional benefits of aiding the reaction , separation or catalyst recycling . Of the various principles of green chemistry, the important one is maximizing the Atom Economy which evaluates the efficiency of chemical transformation and is calculated as :

% Atom Utilization [3]

= Molecular weight of desired product X 100

Molecular weight of

(desired product+ waste product)

In the present study , few derivatives of acetanilide (I IV) are synthesized by conventional method as well as green synthesis method . The synthesized compounds are characterized by their physical constants and FTIR . Both the method gives the desired products , but by applying the green synthesis method , we can able to avoid the use of acetic anhydride and formation of by products . Moreover , the atom economy was obtained in the range of 72 % to 82 % which indicates the complete use of chemicals . Thus , concept of green chemistry can be applied to various synthetic methods . This may leads to generation of eco friendly synthetic chemistry .

II. MATERIALS AND METHOD

Apparatus : The melting points were determined by open capillary method and are uncorrected . Infrared spectra were recorded on FTIR 8400s Shimadzu using KBr .

Chemicals and Reagents : Aniline , p - chloroaniline , p - toluidine , p - nitroaniline , acetic anhydride , conc . HCl , sodium acetate , glacial acetic acid , zinc dust and methylated spirit are from Loba Chem Pvt . Limited , Mumbai . All solvents were distilled before use and dried whenever required .

Synthesis of compounds (I-IV) by conventional method:

In a 250 ml beaker containing 125 ml of water, 4.6 ml of cone. HCI and 5.1 g of aniline / substituted anilines were introduced. Stirred until all the anilines passes completely into solution. To the resulting solution, 6.9 g (6.4ml) of redistilled acetic anhydride was added and stirred until it was dissolved. Poured immediately in a solution of 3.8 g of crystalline sodium acetate in 25 ml of water. Stirred vigorously and cooled in ice . Filtered the acetanilide and substituted acetanilides with suction washed with 110ml water, drained well and dried upon filtn paper. The crude products were *recrystallized from boiling water and methylated spirit.*

Non Green component: Acetic anbydride leaves one molecule of acetic acid unused

Synthesis of compounds (I-IV) by 'Green Chemistry' method:

A mixture of aniline/substituted anilines(3.3g) and zinc dust (0.16g) in acetic acid (10ml) in 100ml round bottom flask was heated over a gentle flame using water condenser. Heating was continued for about 45min., the reaction mixture was then carefully poured in cold water (33ml) in 250 ml beaker with vigorous stirring. The

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shining crystals of p[product were separated slowly . after 15 min. crystals were collected by filtration. The solid crystals were washed over the Buchner funnel with water and product was dried and crystallized in boiling water.

Green context: Minimize waste by-products, avoid use of acetic anhydride

III. RESULTS AND DISCUSSIONS

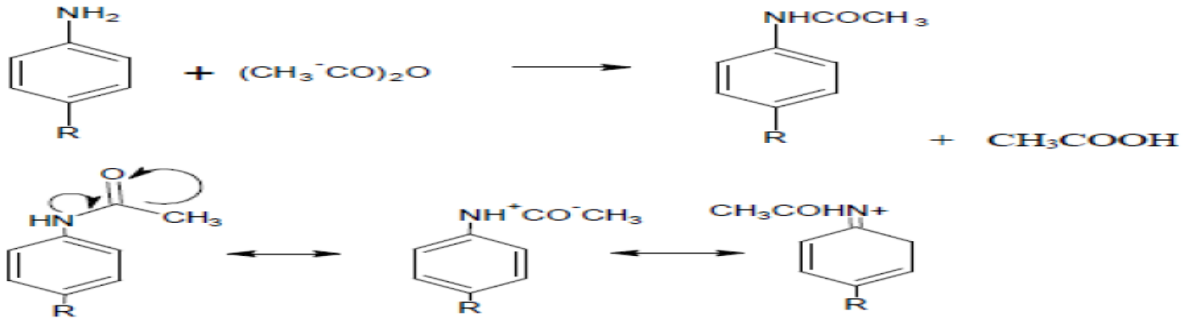
The synthesis acetanilide and its derivatives was carried out successfully by using both conventional method as well as green chemistry method. The synthesized product were recrystallized and melting point was taken which are compatible with the reported melting points. The percent yield obtained by green chemistry method was found to be more than that of conventional method . All the compounds were characterized by FTIR which shows the presence of aromatic ring(3055-3122cm^{-1}) , amine group(3275-3481cm^{-1}), amide (1631-1676cm^{-1}) that characterized the said compounds. The atom economy was calculated on the basis of the molecular weight of the desired product and molecular weight of all products. From this calculation, it was seen that the atom economy is more in case of green chemistry than by conventional method of synthesis. The found value signify the utility of method in which atom economy was obtained in the range of 70% to 75%. Results are shown in table

Table

Comp. No.	R	Green Synthesis Method			Conventional Method		Atom Economy
		%Yield	M. P. (^{o}C)	FTIR (cm^{-1})[7]	%Yield	M. P. (^{o}C)	
I	-H	79.78%	112°C	Aromatic- 3072 NH-3275 Amide-1676 Methyl-1448	55.66%	114°C	69.92 %
II	-CH_3	82.22%	146°C	Aromatic- 3122 NH-3290 Amide-1662 Methyl-1454 Methyl-1402	76 .67%	148-149° C	71.29 %
III	-NO_2	72.09%	210-212° C	Aromatic-3055 NH-3481 Amide-1631 Methyl-1444 Nitro-1402	64.78%	215-216°C	75.00 %
IV	-Cl	76.00%	182-183°C	Aromatic-3066 NH-3304 Amide-1664 Methyl-1371 Chloro-707	59.67%	179°C	73.34 %

Scheme of Synthesis

Scheme of Synthesis and Mechanism by conventional method :[4, 5]



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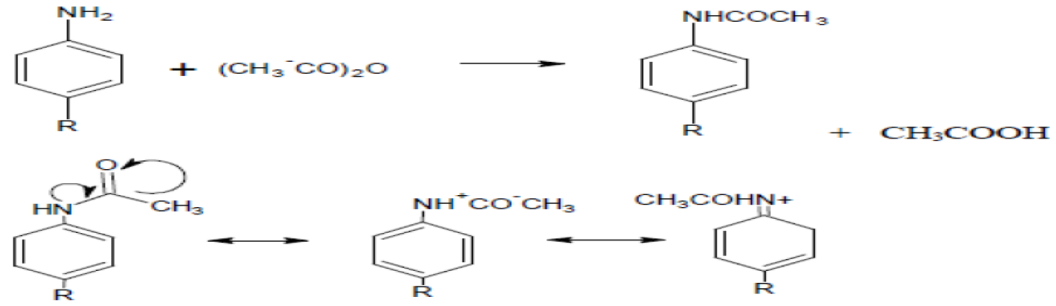
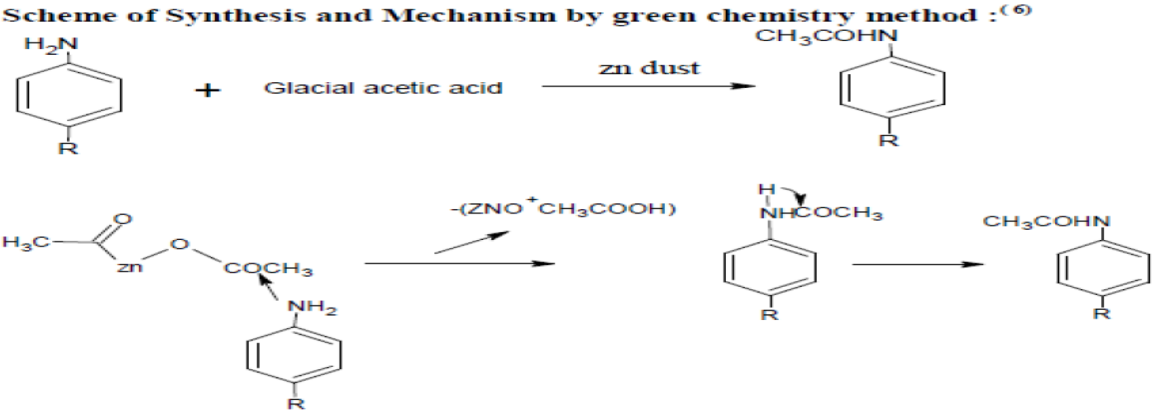
Scheme of Synthesis

Scheme of Synthesis and Mechanism by conventional method :[4,5]



Scheme of Synthesis and Mechanism by green chemistry method :[6]



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