RSC | Advancing the Chemical Sciences

Costing of an Aliphatic Nitrile for use as a Lemon Bleach Fragrance

Once a chemical company has developed a new compound or formulation, a business case must be prepared to support its full scale manufacture and commercialisation. As part of a business case, a full costing of the compound must be produced. Once the full cost of the compound has been determined and the required profit margin decided upon then the selling price can be set.

In this exercise you are asked to carry out a full costing for the production of an aliphatic nitrile, either 3-methyloctanonitile, 3-methyldecanonitrile or 2-methyldecanonitile, suitable for use as a fragrance in lemon bleach (see Lemon Bleach Scenario). A laboratory production method of these nitriles is described in the US patent number 4,579,680 by Charles Sell. A copy of this patent is attached. Using the information provided within the patent (procedure A for alpha-substituted nitriles or procedure B for beta-substituted nitriles) and the assumptions and guidance stated below prepare a full costing for one of the nitriles. Add your cost figures to the cost table below, expanding the table to include as many rows as you need, using one row for each individual cost item. List variable costs first, then direct fixed costs then indirect fixed costs (overheads). If further assumptions are needed then you are asked to make your own assumptions, which should be in keeping with the case study of the costing exercise.

The purpose of this exercise is to recognise and estimate the many different types of costs that should be included within a costing and not necessarily whether the cost figure determined is realistic or not. However, you may wish to consider whether your estimates derived from a laboratory procedure are realistic for a full scale manufacturing operation.

Assumptions

Production capacity: 10 tonne per year (t a^{-1})
Cost of raw materials: obtain from the quantity/process information supplied within the patent and prices from a chemical catalogue (e.g. SigmaAldrich).
Cost of Solvents: assume solvents are recycled by distillation with a 5% loss per batch
Cost of Services: estimate usage and obtain price information from Utility companies.
Cost of equipment: assume the reactor vessel is 10 litre in size and estimate costs from laboratory equipment suppliers.
Cost of labour: assume one process operator will be needed and estimate cost from average salary levels.
Cost of production site: assume that a laboratory of one room in size will be needed and estimate cost from average domestic house rental prices.
Management Overhead: assume 0.2 of a local production manager and 0.05 of a senior business manager will be needed and estimate cost from average salary levels.
Technical Support: assume 0.1 of a local analyst will be needed for quality control.
Marketing Support: assume 0.1 of a national sales officer will be needed to deal with customers.
Logistics: assume the product is delivered to customers in 10 litre containers by lorry.
Waste disposal: assume all the raw materials and processing chemicals not ending up in the finished product are disposed of with a local disposal company.

Costing for Aliphatic Nitrile (*inset product name*):

Cost Item	Cost figures used (variable units)	Cost per kg of nitrile (£ kg^{-1})	Cost per year (£ a^{-1})
Variable Costs:			
Total =			
Direct Fixed Costs:			
Total =			
Indirect Fixed Costs:			
Total =			
Total Cost =			

From the cost table information derive a linear total cost equation.

United States Patent [19]

Sell

[11] **Patent Number: 4,579,680**

[45] **Date of Patent: Apr. 1, 1986**

[54] **ALIPHATIC NITRILES**

[75] Inventor: **Charles S. Sell**, Kent, England

[73] Assignee: **Internationale Octrooi Maatschappij "Octropa" B.V.**, Rotterdam, Netherlands

[21] Appl. No.: **671,015**

[22] *Filed*: **Nov. 13, 1984**

Related U.S. Application Data

[63] Continuation of Ser. No. 413,446, Aug. 31, 1982, abandoned.

[30] **Foreign Application Priority Data**

Sep. 3, 1981 [GB] United Kingdom 8126748

[51] **Int. Cl.**[4] **A61K 7/46**; C11B 9/00; C11D 3/50

[52] **U.S. Cl.** ..... **252/522 R**; 252/106; 252/174.11; 424/69; 424/70; 424/71; 558/435

[58] **Field of Search** ..... 252/522 R; 260/465.1

[56] **References Cited**

U.S. PATENT DOCUMENTS

Re. 27,332	4/1972	Somerville et al.	252/522 R
2,912,455	11/1959	Smiley	260/465.8 R
3,531,510	9/1970	Blumenthal	252/522 R X
3,739,007	6/1973	Schwager et al.	260/464
3,899,398	8/1975	Cole et al.	203/49
4,193,934	3/1980	Bauer et al.	252/522 R X
4,277,377	7/1981	Webb et al.	252/522 R

OTHER PUBLICATIONS

Fischli, Helvetica Chimica Acta., vol. 61, (1978), pp. 2560–2578.

Arctander, Perfume and Flavor Chemicals, (1969) vol. 1, Compound 1121; vol. 2, Compounds 2130, 2292, 2362 and 3010.

Beilsteins Handbuch der Organischen Chemie; vol. 2, 1942, second supplement; pp. 312, 315, 316, 323.

Beilsteins Handbuch der Organischen Chemie; vol. 2, 1960, third supplement; pp. 825, 826, 831, 832, 848, 853, 863, 864, 865, 979.

Croteau (editor); "Fragrance and Flavor Substances", (1980), pp. 123–128, article by Hagena et al.; D&PS. Verlag, 3017 Pattersen 1, W. Germany.

De Simone, "Perfumer & Flavorist," vol. 4, (1980), pp. 2, 3, 4, 6, 7 and 8.

Sell, et al: Perfumer & Flavorist, 7 (1983), 14–16.

Primary Examiner—Joseph Paul Brust

Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

This invention provides perfume compositions containing certain substituted saturated aliphatic nitriles and some novel nitriles useful as perfumery components.

1 Claim, No Drawings

ALIPHATIC NITRILES

This is a continuation of application Ser. No. 413,446, filed Aug. 31, 1982, now abandoned.

This invention relates to substituted saturated aliphatic nitriles, more particularly to alpha- and beta-substituted nitriles which have been found to have value in perfume compositions.

Various substituted aliphatic nitriles have been known for some years, but hitherto their value as perfume components has not been appreciated. Our work has shown that certain of the alpha- and beta-substituted aliphatic nitriles, some of which are novel, have particular merit in perfumery compositions.

Accordingly, the present invention provides a perfume composition comprising perfume components and an organoleptically discernible amount of a nitrile of the formula:

$$CH_3(CH_2)_nRCN$$

in which

R=—$CHCH_3$— or —$CHCH_3CH_2$— and in which, when

R=—$CHCH_3$—, n is an integer from 5-9 and when

R=—$CHCH_3CH_2$—, n is an integer from 4-8.

In addition, this invention provides certain novel substituted nitriles of particular value in perfume formulations, having the formula:

$$CH_3(CH_2)_nCHCH_3CH_2CN$$

in which n is 6, 7 or 8.

The nitriles useful in perfume compositions provided by this invention have, in addition to their useful odour characteristics, good stability when used in perfume formulations which are to be used or stored in an aggressive environment, such as in soaps, disinfectants, laundry powders and other compositions in which active chemicals are present or which have to withstand the effects of daylight or heat.

The nitriles useful according to this invention may be prepared by various processes, but a convenient process for the preparation of the alpha-substituted nitriles is as follows:

Procedure A

A solution of the required methyl alkyl ketone (50 m mol) and tosylmethylisocyanide (12 g, 60 m mol) in dry diglyme (120 ml) was added over 15 minutes at 0° C. under nitrogen to a stirred solution of potassium t-butoxide (freshly prepared from potassium 4.3 g, 0.11 g atom) in dry t-butanol (100 ml) and diglyme (100 ml). When the addition was complete, the mixture was allowed to warm to room temperature then stirred for 2 hours and left to stand overnight. The resultant solution was poured into water (400 ml) and extracted with light petroleum (3×100 ml, bp 40°-60° C.). The combined organic extracts were washed with water (2×500 ml), then brine (500 ml) and dried ($MgSO_4$). The solvent was removed under reduced pressure and the residue chromatographed using a column (3 cm diameter, 30 cm height) of silica gel with 5% ether in light petroleum (bp 40°-60° C.) as solvent. Those fractions containing the product were freed of solvent under reduced pressure and the residue distilled to give the desired 2-methyl substituted nitrile.

A convenient process for the preparation of the betanitriles is as follows:

Procedure B

The required methyl alkyl ketone (1 mol), cyanoacetic acid (93.5 g, 1.1 mol), ammonium acetate (13 g, 0.17 mol) and toluene (175 ml) were stirred under reflux (pot temperature 140°-160° C.) in a Dean-Stark apparatus until carbon dioxide ceased to be evolved (3-6 hours). The resultant mixture was cooled, washed with saturated aqueous sodium hydrogen carbonate (2×50 ml) and water (50 ml) then the solvent was removed under reduced pressure. The crude mixture of nitriles was then added to one quarter of its volume of 50% aqueous sodium hydroxide to which Tergitol* (3 drops) had been added. The resulting mixture was stirred under reflux for 1 hour then cooled. The organic layer was removed, washed with water (3×50 ml) and distilled. 5% Palladium on carbon (0.1% by weight relative to the nitrile mixture) was then added followed by ethyl acetate (2×weight of distillate) and the suspension stirred vigorously in an atmosphere of hydrogen until uptake of gas ceased. The catalyst was removed by filtration and the solvent by evaporation under reduced pressure. Fractional distillation of the residue afforded the desired 3-methyl substituted nitrile.

*Tergitol is a trade name for a surfactant (Union Carbide).

The following table sets out the physical and the organoleptic properties of the nitriles useful in this invention:

TABLE

Sample	Series	Carbon Chain Length	Name	Structure
1	α-methyl	8	2-methyloctanonitrile	$CH_3(CH_2)_5CHCH_3CH$
2	α-methyl	9	2-methylnonanonitrile	$CH_3(CH_2)_6CHCH_3CN$
3	α-methyl	10	2-methyldecanonitrile	$CH_3(CH_2)_7CHCH_3CN$
4	α-methyl	11	2-methylundecanonitrile	$CH_3(CH_2)_8CHCH_3CN$
5	α-methyl	12	2-methyldodecanonitrile	$CH_3(CH_2)_9CHCH_3CN$
6	β-methyl	8	3-methyloctanonitrile	$CH_3(CH_2)_4CHCH_3CH_2CN$
7	β-methyl	9	3-methylnonanonitrile	$CH_3(CH_2)_5CHCH_3CH_2CN$
8	β-methyl	10	3-methyldecanonitrile	$CH_3(CH_2)_6CHCH_3CH_2CN$
9	β-methyl	11	3-methylundecanonitrile	$CH_3(CH_2)_7CHCH_3CH_2CN$
10	β-methyl	12	3-methyldodecanonitrile	$CH_3(CH_2)_8CHCH_3CH_2CN$

Sample	Preparation	Boiling Point (lit. bp)	Odour Description
1	Procedure A, 76% yield from 2-octanone	78-80° C. at 8 m bar (85 at 10 mm Hg)	Floral jasminic character with some celery aspects and a hint of coconut/lactone - very diffusive.
2	Procedure A, 69% yield	72-73° C. at 3 m bar	Soft, floral, lactonic,

TABLE-continued

	from 2-nonanone	(100 at 10 mm Hg)	jasmine/peachy character.
3	Procedure A, 77% yield from 2-decanone	85–87° C. at 3 m bar (115 at 10 mm Hg)	A fine, light, jasmine/floral character with a soft peach quality.
4	Procedure A, 74% yield from 2-undecanone	84° C. at 1 m bar (133 at 12 mm Hg)	Fresh, floral with some lilac character - tenacious.
5	Procedure A, 59% yield from 2-dodecanone	125–127° C. at 7 m bar (146 at 10 mm Hg)	Soft, floral with a green jasminic type odour - very persistent.
6	Procedure B, 59% yield from 2-heptanone	66–68° C. at 4 m bar (207–8 at 760 mm Hg)	An unusual floral type consisting of a distinct fatty jasminic character combined with an agrumen quality.
7	Procedure B, 16% yield from 2-octanone	93° C. at 8 m bar (95–6 at 2–3 mm Hg)	Fresh, jasminic floral type with a slightly green quality.
8	Procedure B, 49% yield from 2-nonanone	72–74° C. at 0.7 m bar	Soft, citrus floral - reminiscent of jasmine.
9	Procedure B, 35% yield from 2-decanone	99–100° C. at 3 m bar	Light, fresh, green, floral suggesting lilac, with slight citrus undertones.
10	Procedure B, 26% yield from 2-undecanone	95–97° C. at 0.7 m bar	Distinct orange character which is suffused by a light green sea-fresh quality.

The following are two examples of perfume compositions comprising the nitriles of this invention:

Formula 1	
Phenylethyl Alcohol	30.5
Terpineol	6.0
Paratertiary butyl cyclohexyl acetate high cis (PPL)	15.0
Benzyl Salicylate	14.8
Cinnamic Alcohol	10.0
Sandalone (PPL)	5.0
Galaxolide (IFF)	3.0
Hexyl Cinnamic Aldehyde	10.0
Coumarin	2.0
Rose Base AB 380 (PPL)	2.0
Isoeugenol	0.1
Vetivert Brazilian	0.1
Nitrile No 3	1.5

Formula 1 in the absence of nitrile 3 has a floral, woody bouquet suitable for a toilet soap. The addition of 1.5% of nitrile 3 enhances the overall freshness, giving a light floral, fruity effect. Using the above formulation but substituting nitrile 9 in place of nitrile 3, a perfume is created having an added fresh lightness with an enhanced floral, fruity and citrus character.

The three novel nitriles provided by this invention are those numbered 8, 9 and 10 in the samples list and their mass spectral data are as follows.

Sample		Base Peak	M1	M2	M3	M4	M5
8	C_{10}	41	43:85	57:84	68:66	55:50	96:46
9	C_{11}	41	57:85	43:84	68:56	55:50	69:43
10	C_{12}	41	57:92	43:90	55:54	68:53	70:48

Perfumes formulated using as an odorous component the nitriles provided by this invention may be employed in the various products, such as soaps, detergents, hairsprays, talcum powders and the like, which are normally augmented by the addition of a perfume.

I claim:

1. A perfume composition comprising at least two perfume components and, in addition, as an odour providing component, an organoleptically discernible amount of a nitrile of the formula:

$$CH_3(CH_2)_nRCN$$

in which

R=—$CHCH_3$— or —$CHCH_3CH_2$— and in which, when

R=—$CHCH_3$—, n is an integer from 5–9 and when R=—$CHCH_3CH_2$—, n is an integer from 4–8,

the amount of the nitrile not exceeding 95% by weight of the perfume composition and the nitrile being characterized by its stability in the use or storage of said composition.

* * * * *