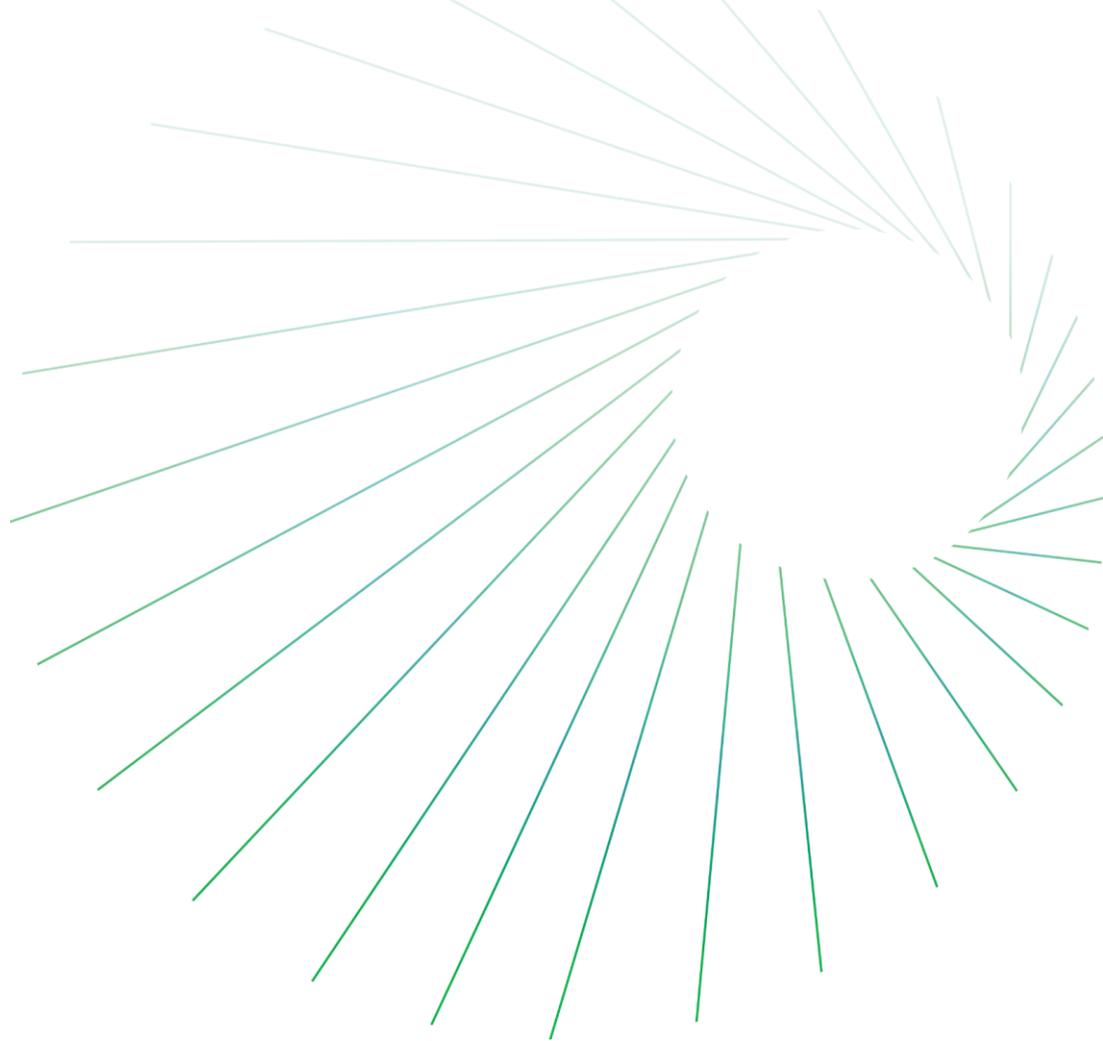


# Maleic Anhydride from n-Butane by Scientific Design Co. process

PEP Review 2020-14

June 2020



## PEP Review 2020-14

# Maleic Anhydride from n-Butane by Scientific Design Co. process

**Praveer Joshi**, Associate Director

---

### Abstract

This review examines the technology and economics of producing maleic anhydride (MAN) using n-butane as the raw material. The process that this review evaluates is patented and commercially licensed by Scientific Design Inc. The evaluation process entails a series of steps involving a brief process review, followed by a more detailed parametric information about the technology, such as process operation key conditions, process description, material and energy balance, equipment sizes, utilities consumption, and a process flowsheet. Process economics are presented in the latter part of the review.

The technology is basically a two-step process. In the first step, n-butane is oxidized in tubular fixed-bed reactors to produce maleic anhydride (MAN) and other gases, such as carbon dioxide and carbon monoxide as well as certain amount of by-products, such as fumaric, acrylic, and acetic acids. The second step is to isolate the maleic anhydride (MAN) formed using water as the main solvent. Water dissolves the acids as well as maleic anhydride (MAN), and the remaining gases are incinerated in a flare/vent system. The maleic anhydride (MAN) is then separated from water by three phase azeotropic distillation using p-Xylene.

In the end, the economics of maleic anhydride (MAN) production are presented for an integrated plant converting n-butane to maleic anhydride (MAN). Our estimates indicate that the net production cost of maleic anhydride (MAN) from this route is 34.66 ¢/lb. Seeing that the market price of MAN is approximately 44.5¢/lb, a new green field plant using this technology appears to be a feasible proposition.

# Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
	Product usage	5
	Unsaturated polyester resin (UPR)	5
	Production of 1,4-butanediol	6
	Lube oil additives	6
	Co-polymers	6
	Agriculture chemicals	6
	Production of fumaric acid and malic acid	6
	Other applications	7
	Global trends for maleic anhydride production/consumption	7
<b>2</b>	<b>Summary</b>	<b>9</b>
	Manufacturing processes	9
	Oxidation of benzene	10
	Oxidation of n-butane	10
	Oxidation of n-butenes	11
	Co-product of phthalic anhydride manufacture	11
<b>3</b>	<b>Technical review</b>	<b>13</b>
	Review of Vanadium Phosphorous Oxide (VPO) catalyst	13
	Oxidation reaction of n-Butane	14
<b>4</b>	<b>Process economics and design basis</b>	<b>15</b>
	Product properties	15
	Process design basis	15
	Process description	16
	Oxidation of n-Butane	16
	Isolation of MAN from reaction gases	19
	Heat material balance tables	20
	Utility summary	26
	Cost estimation	27
	Fixed capital cost	27
	Waste treatment	28
	Production cost	29
	Economic discussion	31

## Tables

Table 1.1 Maleic anhydride from n-Butane by Scientific Design Co.process	8
Table 4.1 Typical physical properties of MAN	15
Table 4.2 Design basis	16
Table 4.3 Material balance (design case)	20
Table 4.4 Major equipment list	25
Table 4.5 Utility summary	27
Table 4.6 Total capital investment cost	29
Table 4.7 MAN production cost	30
Table 4.8 Carbon and water footprint	31

## Appendix D Figure

Figure 1 PFD for MAN Production from n-Butane	44
---	----

---

## IHS Markit Customer Care:

CustomerCare@ihsmarkit.com

Americas: +1 800 IHS CARE (+1 800 447 2273)

Europe, Middle East, and Africa: +44 (0) 1344 328 300

Asia and the Pacific Rim: +604 291 3600

---

### Disclaimer

The information contained in this presentation is confidential. Any unauthorized use, disclosure, reproduction, or dissemination, in full or in part, in any media or by any means, without the prior written permission of IHS Markit Ltd. or any of its affiliates ("IHS Markit") is strictly prohibited. IHS Markit owns all IHS Markit logos and trade names contained in this presentation that are subject to license. Opinions, statements, estimates, and projections in this presentation (including other media) are solely those of the individual author(s) at the time of writing and do not necessarily reflect the opinions of IHS Markit. Neither IHS Markit nor the author(s) has any obligation to update this presentation in the event that any content, opinion, statement, estimate, or projection (collectively, "information") changes or subsequently becomes inaccurate. IHS Markit makes no warranty, expressed or implied, as to the accuracy, completeness, or timeliness of any information in this presentation, and shall not in any way be liable to any recipient for any inaccuracies or omissions. Without limiting the foregoing, IHS Markit shall have no liability whatsoever to any recipient, whether in contract, in tort (including negligence), under warranty, under statute or otherwise, in respect of any loss or damage suffered by any recipient as a result of or in connection with any information provided, or any course of action determined, by it or any third party, whether or not based on any information provided. The inclusion of a link to an external website by IHS Markit should not be understood to be an endorsement of that website or the site's owners (or their products/services). IHS Markit is not responsible for either the content or output of external websites. Copyright © 2019, IHS Markit™. All rights reserved and all intellectual property rights are retained by IHS Markit.

