'Impact Booster'

Tobacco Firm Shows How Ammonia Spurs Delivery of Nicotine

Brown & Williamson Papers Claim Wide Industry Use Of Additive in Cigarettes

Inside 'the Soul of Marlboro'

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Leading U.S. tobacco companies enhance nicotine delivery to smokers by adding ammonia-based compounds to their cigarettes, according to two major internal reports by Brown & Williamson Tobacco Corp.

The $45 billion tobacco industry vehemently denies that it seeks to keep smokers hooked by increasing nicotine levels in cigarettes. But the confidential reports obtained by this newspaper indicate that, while cigarette makers may not bolster nicotine content per se, most are adding chemicals that increase the potency of the nicotine a smoker actually inhales.

The lengthy internal reports by the nation's No. 3 cigarette maker are remarkable because both were drafted in the early 1990s and thus provide a rare window into recent activities of B&W and its leading competitors. One of the confidential documents is especially intriguing because of its competitive analysis of ammonia use in Marlboro, Philip Morris U.S.A.'s market-dominating brand.

At a time when America's tobacco sellers are already under intense legal and regulatory attack, the Brown & Williamson research could create new problems for the industry. In particular, the analysis of how B&W and its rivals use chemicals that, the reports assert, enhance nicotine delivery could assist efforts by the Food and Drug Administration to regulate tobacco as a drug.

Company Statement

Brown & Williamson, a unit of London-based B.A.T Industries PLC, wouldn't respond to specific questions about the documents, saying they "relate to B&W's proprietary manufacturing processes and competitive product research, all of which constitute B&W trade secrets." The company emphasizes that it has spent a great deal of money on the reports and that their release "would be invaluable to competitors and cause damage to B&W."

Despite the assertions in its own reports about improved nicotine delivery, the company adds that "the use of ammonia in the processing [of tobacco] does not increase the amount of nicotine absorbed by the smoker."

Other tobacco companies, while acknowledging use of ammonia-releasing chemicals to enhance flavor, also deny that ammonia affects nicotine delivery. Lorillard Tobacco Co., a unit of Loews Corp., says that interest in the subject "probably proceeds from incorrect indications by the FDA that this substance increases the transfer of nicotine or the per-puff delivery of nicotine to the smoker. Neither of those things is correct."

Handbook for Blenders

The first of the two Brown & Williamson documents to be circulated within B&W was a 1991 handbook for leaf blenders and product developers laying out the rudiments of ammonia chemistry. FDA Commissioner David A. Kessler quoted briefly from the primer last June in congressional testimony, but he neither elaborated on its contents nor revealed which company was responsible for it.

The 54-page handbook explains how ammonia scavenges nicotine from tobacco and converts it into a form with greater impact on smokers. Nicotine in this "pharmacologically active" or "free" form has a more powerful effect than nonammoniated nicotine because it gets absorbed more quickly into a smoker's bloodstream, according to government and independent scientists. Thus, by harnessing ammonia-producing additives, a manufacturer can enhance nicotine delivery without actually adding nicotine, these scientists say.

The leaf blenders' manual says that Brown & Williamson adds ammonia-releasing chemicals to "almost all" its nonmenthol brands, which include Viceroy, Raleigh and GPC. The chemicals supplement ammonia occurring naturally in tobacco. The "free" nicotine liberated by the additives "is associated with increases in impact and satisfaction reported by smokers," the B&W manual concludes.

Hot Buttons

In using the terms "impact" and "satisfaction," the Brown & Williamson document obliquely addresses the hot-button issue of smokers' nicotine cravings. These terms are among those consistently used by the industry as euphemisms for the effects of nicotine, FDA officials say. "Despite the buzzwords used by industry, what smokers are addicted to is not 'rich aroma' or 'pleasure' or 'satisfaction.' What they are addicted to is nicotine, pure and simple," Dr. Kessler has testified in Congress.

Ammonia increases "impact," says Neil Benowitz, a professor and nicotine-research specialist at the University of California in San Francisco, because "the faster nicotine is absorbed, the more reinforcing or satisfying it is and the greater its psychological effect."

Nicotine is widely viewed by scientists as the active component that makes cigarettes addictive, according to several surgeon general reports. In contrast, the industry has always described nicotine as

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providing better flavor, in addition to other benefits, and has denied that it promotes addiction. Tobacco companies also maintain that any links between cigarette smoking and heart disease, cancer or other ailments are unproven.

The second document, dated Oct. 23, 1992, is Brown & Williamson's competitive analysis of Marlboro—an outgrowth of a B&W effort code-named the Worldwide Best Project. In a Dec. 6, 1991, strategy memo, the company described its ultimate objective as "beating Marlboro" by developing products that were "significantly superior" and "significantly preferred" to Marlboro. Brown & Williamson scientists and marketing staffers then collaborated on the 1992 study, titled "PM's Global Strategy: Marlboro Product Technology."

B&W's abstract of the document—the full report includes 46 pages of text and dozens of charts and tables—says the information in the paper "has been summarized and reviewed by scientists in the various groups and represents a collective judgment of the critical product technologies utilized by PM."

After providing an analysis of Marlboro's composition and design, the report concludes: "What product technology, then, makes Marlboro a Marlboro? Looking at all of the technology employed in Marlboro on a worldwide basis, ammonia technology remains the key factor. . . . Ammonia technology is critical to the Marlboro character, taste, and delivery."

Philip Morris U.S.A., a unit of Philip Morris Cos., didn't respond to questions about the Brown & Williamson documents. Earlier, in response to inquiries about use of ammonia in cigarettes, Philip Morris said it "does not use ammonia in the cigarette manufacturing process to increase the amount of nicotine inhaled by the smoker or to 'affect the rate of absorption of nicotine inhaled by the smoker' or to 'affect the rate of absorption of nicotine in the bloodstream of the smoker.' "

In highlighting the role of ammonia in nicotine delivery, the Brown & Williamson documents appear at odds with certain past statements by industry representatives. For instance, after visiting Brown & Williamson's headquarters in Louisville, Ky., in May, FDA officials asked the company about the effects of diammonium phosphate, or DAP, one key ammonia additive. In a June 14 letter to the FDA, company law firm King & Spalding responded: "The primary purpose for using DAP is to increase taste and flavor, reduce irritation, and to improve body." The letter acknowledged that DAP also increases nicotine delivery but called this "an incidental effect."

Also in June, after the FDA's Dr. Kessler testified before Congress about ammonia in cigarettes, Philip Morris issued a statement saying the implication that "tobacco companies are adding ammonia to their cigarettes to increase nicotine deliveries in an attempt to 'addict' smokers" is "not true." Philip Morris acknowledged using "small amounts of ammonia and related compounds" in the cigarette-manufacturing process for reasons such as flavoring. But it said: "There is no indication that ammonia compounds in our cigarettes alter the amount of nicotine the smoker inhales."

However, Brown & Williamson's Marlboro report characterizes each effect of Marlboro's ammonia technology—including "ammonia in smoke" and "free nicotine/nicotine transfer"—as among "key desirables." Others listed include enhancing flavor and reducing the harshness of smoke. And the leaf blenders' handbook, while also linking ammonia to better taste and less irritation, is explicit in describing ammonia as an "impact booster" and in detailing how it affects nicotine delivery.

"Ammonia, when added to a tobacco blend, reacts with the indigenous nicotine salts and liberates free nicotine," the manual explains. "As a result of such change the ratio of extractable nicotine to bound nicotine in the smoke may be altered in favor of extractable nicotine. As we know, extractable nicotine contributes to impact in cigarette smoke and this is how ammonia can act as an impact booster."

SMOKING MACHINE

Smokers have no way of gauging the effect of ammonia on nicotine delivery, says Jack Henningfield, chief of the pharmacology branch at the government's National Institute on Drug Abuse. This is because the industry's "smoking machine"—which takes small puffs of smoke from cigarettes to measure tar, nicotine, carbon monoxide and other chemicals—registers only the total nicotine content. The device, used in compliance with Federal Trade Commission rules, doesn't distinguish between the slower-acting salt-bound nicotine and the more potent "free" nicotine that ammonia helps release. So an ammoniated cigarette that delivers more potent nicotine to smokers would measure the same as a cigarette with no such additives, Mr. Henningfield says.

Put simply, the government scientist adds, "The machines aren't measuring the effects that ammonia has on nicotine dosing to smokers."

The direct health effects of nicotine appear to be relatively minor, although a 1989 surgeon general report says nicotine can be a factor in heart disease and pregnancy problems. It is by hooking smokers on cigarettes—which deliver numerous carcinogenic substances in tar—that nicotine most clearly contributes to illness and death, federal health officials say.

The industry's use of ammonia-releasing compounds that enhance nicotine delivery is having far-reaching consequences, government scientists and former tobacco-industry researchers believe. In addition to making full-flavor cigarettes more appealing, they say, the use of ammonia helps explain how tobacco companies have been able to reduce tar levels in their cigarettes over the past two decades while still furnishing smokers with sufficient nicotine to satisfy smokers' cravings.

"With ammonia, you get a bigger jag with less nicotine because it is absorbed faster," says John Kreisher, a former associate scientific director for the Council for Tobacco Research, an industry-sponsored group that funds independent scientists. "Ammonia helped the industry lower the tar and allowed smokers to get more bang with less nicotine. It solved a couple of problems at the same time."

"Consumers want lower tar and nicotine ratings but still need high nicotine, and ammonia gives them both," Mr. Henningfield says. About two-thirds of smokers now buy cigarettes with reduced tar and nicotine.

The Brown & Williamson disclosures come at a time when the industry faces a variety of legal proceedings in addition to the FDA's regulatory effort. These include a pending grand-jury investigation in Washington into whether industry executives committed perjury in their congressional testimony regarding nicotine manipulation. In addition, tobacco companies face lawsuits brought by four states seeking reimbursement for the costs of treating smoking-related illnesses. Meanwhile, in a federal court in New Orleans, the industry is the target of a giant federal class-action lawsuit claiming that smoking is an addiction and that the industry withheld this fact from consumers.

The industry is vigorously fighting all these efforts. Of the FDA's actions, Philip Morris says: "We believe that Commissioner Kessler's allegations regarding the use of ammonia in the cigarette manufacturing process are scientifically unsound, lack merit, and do not support the FDA's illegal assertion of jurisdiction over the cigarette industry."

Ammonia chemistry isn't the only way the tobacco industry exerts control over nicotine delivery, according to the FDA. In a report it released in August to support its proposed regulation of cigarettes, the agency detailed the methods it says the industry uses to "manipulate nicotine delivery at each stage of production." FDA officials believe that ammonia technology works in tandem with additional techniques, such as blending different varieties of tobacco to ensure sufficient nicotine levels and using filters that, by letting in more air, deliver proportionately more nicotine than tar. The industry has denied that any such techniques are designed to promote addiction.

LONG HISTORY

But the Brown & Williamson documents emphasize the importance and long history of ammonia technology in nicotine delivery, tracing Philip Morris's quiet use of this technology back more than 30 years. According to the leaf blenders' manual, U.S. cigarettes were made entirely of various types of tobacco leaf until the early 1950s, when Philip Morris began introducing tobacco leftovers such as stems, dust and broken leaves as a money-saving filler in its cigarettes.

The reports don't say why ammonia entered the picture. But two former Philip Morris employees link the introduction of the additive to a problem the company faced with its reconstituted tobacco filler, called bandcast. "The product just fell apart during processing," says Howard Spielberg, manager of Philip Morris's flavor group until 1993, when he took early retirement.

Groping for a way to make the filler hold together in a strong sheet of tobacco, Philip Morris experimented with ammonia, Mr. Spielberg and another former employee say. The company found that the ammonia compound DAP, which released glue-like pectins, did the job. Beyond resolving Philip Morris's manufacturing hitch, DAP turned out to suit the company's needs in other ways as well, the leaf blenders' manual says.

For one thing, applying the odorless, white crystalline powder to the reconstituted tobacco "dramatically altered" the taste of the cigarette. "Was this by design or by accident?" the manual writers wonder. "We don't know for sure, but it is a major player in establishing the taste of Marlboro." In addition to affecting flavor, DAP serves as an "impact booster" and a "satisfaction promoter," the manual says.

NICOTINE PICK-UP

The B&W report on Marlboro cites an experiment showing the effectiveness of Marlboro's ammonia-rich bandcast filler in scavenging nicotine from the rest of the tobacco in the cigarette. The experiment showed that the free-nicotine level in the filler almost tripled once it was placed in an actual Marlboro because the added ammonia liberated nicotine from the surrounding blend. In the Marlboro report, Brown & Williamson says its 1991 data "clearly show the nicotine pick-up potential" of ammoniated bandcast.

Marlboro's introduction of bandcast in the 1950s—when Philip Morris was the nation's smallest cigarette maker—roughly coincided with a dramatic change in the image of the brand, which had been introduced in 1924 primarily as a women's cigarette. Marlboro was relaunched in 1954 with its now-famous red and white box and with cowboys among its mix of macho advertising images. Philip Morris made the cowboy its sole "Marlboro Man" in 1963. The company says it introduced DAP into bandcast in the 1960s.

In the 1970s, Philip Morris began shifting to a different kind of reconstituted tobacco that was cheaper than bandcast to manufacture, the Brown & Williamson manual says. But by adding ammonia-releasing chemicals—including DAP and urea—to the new filler, the company was able to maintain its level of nicotine delivery, according to data in the report on Marlboro.

The company, however, never abandoned bandcast altogether, leading B&W to conclude in the manual that DAP-treated bandcast is "the soul of Marlboro."

The manufacturing adjustments coincided, the Brown & Williamson manual says, with "explosive growth" in Marlboro sales. The brand now boasts a 30% share of the U.S. cigarette market.

IMITATING MARLBORO

Philip Morris's use of ammonia in nearly all its brands has been widely emulated within the tobacco industry, according to the Brown & Williamson handbook. Brown & Williamson itself developed and now uses a reconstituted tobacco called CPCL, specifically designed to replicate Philip Morris's version, the handbook says.

When Brown & Williamson made an experimental cigarette using 100% CPCL, the cigarette registered what the manual calls "nicotine transfer efficiencies" of 22%, against normal values of 12% to 15% for tobaccos. The manual characterizes the enhanced nicotine transfer as "unusually high."

Brown & Williamson's manual says its actual product specifications call for CPCL to make up as much as 10% of its blend. It notes that a cigarette containing 9% CPCL has, among other benefits, "higher impact" than the same blend without the ammoniated tobacco.

In 1992, the year the Marlboro report was completed, B&W changed some of its products, according to an internal memo dated Jan. 8, 1993. The memo reports that newly reformulated brands include Richland and Viceroy 100s. It couldn't be determined whether the changes included adding ammonia.

'SENSORY IMPROVEMENTS'

The memo also states that, among smokers on test panels, Brown & Williamson had achieved "sensory improvements" in Kool, in part by applying mild "root" technology, a company term for adding ammonia-releasing chemicals. The document, which summarizes research and development accomplishments in 1992, doesn't disclose whether Brown & Williamson actually marketed this version of Kool.

Among competitors, No. 2-ranked R.J. Reynolds Tobacco Co. appears to ammoniate its tobacco sheets in certain brands, most notably Winston, according to the Brown & Williamson handbook. Reynolds, a unit of RJR Nabisco Holdings Corp., won't comment on any particular brand, citing competitive concerns. In general, the company says it adds "minuscule" amounts of ammonia-based compounds to the reconstituted tobaccos it uses in certain brands. It says it considers these compounds "processing agents," not "additives," because almost all of the ammonia has reacted with materials in tobacco before the cigarette is lit.

The company uses the compounds only to make "smoke smoother" and its "product taste smoother," says Robert Suber, Reynolds's director of health and environmental sciences. "What we are saying is we sell sensory impact in tobacco products, smoke feel in the mouth, flavors and types of tobacco—not just nicotine, as Dr. Kessler would have people believe," he adds.

R.J. Reynolds's addition of ammonia-based compounds is so negligible that there is no difference in the amount of ammonia or nicotine in smoke from cigarettes made with or without them, Mr. Suber says. He adds that the company doesn't have a way to measure "free" nicotine, which he calls "a theoretical thing."

Lorillard, maker of Kent and Newport, has been applying DAP directly to tobacco leaves for many years, the B&W manual says, and "we now find a considerable amount of DAP in the recon used in many Lorillard brands."

In addition to saying that ammonia doesn't affect nicotine delivery in its cigarettes, Lorillard questions whether DAP can produce such an effect. "In the research lab, we have looked at the use of DAP in even greater amounts than we use it commercially, and even at those greater amounts we have observed no increase in the transfer of nicotine," a spokesman says.

The B&W leaf blenders' manual says that American Tobacco Co., acquired by Brown & Williamson last year, also uses a filler containing DAP in some new brands.

Only Liggett Group, a unit of Brooke Group Ltd., appears not to have used ammonia technology, according to the B&W manual. Liggett, which declined to comment, citing competitive concerns, is the nation's smallest tobacco firm, with a market share of 2.3% ✣

From Brown & Williamson's response to questions raised for this article:

Based entirely on publicly available information, you should be aware that:

1. Ammonia occurs naturally in foods (e.g., coffee and roast beef), and in tobacco.
2. Our bodies naturally produce ammonia at levels thousands of times higher than amounts found in cigarette smoke.
3. Ammonium hydroxide is an approved additive for food, and processes using it are widely used in the manufacture of caramel, baked goods, meat products, and confectioneries.
4. The use of ammonia in the processing does not increase the amount of nicotine absorbed by the smoker. Therefore, the deliveries of nicotine measured using the Federal Trade Commission methodology are in no way affected.
5. The use of ammonia technology by our industry has been known for decades as it relates to cigarette manufacturing, and has been a matter of public record through patent filings for over 25 years. In addition, ammonia compounds are among compounds found in the publicly-released 1993 Tobacco Additives List.

In summary, you can see from the above that ammonium hydroxide is used extensively in consumer goods. In our case, we use it to enhance flavor.

Fine-Tuning Marlboro

When Brown & Williamson delved into the mysteries of Marlboro, it dug out more than just ammonia.

The study of Marlboro states, for instance, that the amount of sugar in a U.S. Marlboro had risen to 12.3% of the blend by the end of 1986, compared with 9.5% before 1983. Although the study doesn't explain the reason for this increase, the FDA's report on nicotine manipulation says that sugars are often added to tobacco blends to smooth out the harsh taste of smoke. The taste becomes harsher as nicotine levels rise, according to the FDA.

Brown & Williamson's report also observes that Philip Morris has increased the level of "reducing sugars"—those sugars that specifically interact with ammonia to enhance tobacco flavor—to 8.6% from 5.9% during the same period.

Philip Morris didn't respond to questions about the Brown & Williamson documents.

Retaining Moisture

Brown & Williamson further reported an increase in certain other Marlboro additives. Its analysis says that after 1988, Marlboro's level of two so-called humectants—glycerine and propylene glycol—jumped 15% and 36% respectively. The Marlboro study says these humectants "can influence the blend's equilibrium moisture content, moisture retention capability, and smoke quality."

The FDA has said that by maintaining moisture, humectants ensure that the nicotine content of a blend doesn't fall. They also help smoke particles that contain nicotine to combine into larger particles, making smoke smoother and easier to inhale, the FDA report says.

Levels of acetaldehydes, a class of chemicals in smoke, have risen, too, the Brown & Williamson competitive report shows. The data reflect a 40% increase between 1982 and 1991 in acetaldehydes in U.S. Marlboros King Size. In its report on nicotine manipulation, the FDA said that, in the early 1980s, Philip Morris conducted research into the optimal ratio of acetaldehyde to nicotine "that would maximize the positive reinforcing effects of cigarettes; i.e. maximize their potential to produce dependence in smokers."

Letting Air In

Besides fine-tuning Marlboro's chemistry over the past two decades, Philip Morris has also changed certain aspects of how the product is put together, Brown & Williamson's report says. Among those changes, the report says, has been a sharp increase in the amount of air that smokers can draw through the filters of U.S. Marlboro. The competitive analysis says that Philip Morris didn't ventilate its Marlboro King Size filters at all in 1978. However, ventilation was apparent by 1979, and it had increased significantly by the end of the following decade.

The Marlboro study doesn't elaborate on the reason for this increase. The FDA's report says that with ventilation the manufacturer "has selectively reduced tar while delivering a higher percentage of available nicotine to the smoker."

—Alix M. Freedman