STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI AIR CONSERVATION COMMISSION

PERMIT TO CONSTRUCT

Under the authority of RSMo 643 and the Federal Clean Air Act the applicant is authorized to construct the air contaminant source(s) described below, in accordance with the laws, rules and conditions as set forth herein.

Permit Number: 082015-009

Project Number: 2015-06-005
Installation Number: 183-0110

Parent Company: Zoltek Corporation

Parent Company Address: 3101 McKelvey Road, Bridgeton, MO 63044

Installation Name: Zoltek

Installation Address: 11 Missouri Research Park Drive, St. Charles, MO 63304

Location Information: St. Charles County (S34, T46N, R3E)

Application for Authority to Construct was made for:
The installation of two (2) new pultrusion lines and associated support equipment. This review was conducted in accordance with Section (5), Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required.*

☐ Standard Conditions (on reverse) are applicable to this permit.

☑ Standard Conditions (on reverse) and Special Conditions are applicable to this permit.

Ryan Schott

Prepared by
Ryan Schott
New Source Review Unit

Kendall B. Hale for

Director or Designee
Department of Natural Resources

AUG 13 2015

Effective Date

STANDARD CONDITIONS:

Permission to construct may be revoked if you fail to begin construction or modification within two years from the effective date of this permit. Permittee should notify the Air Pollution Control Program if construction or modification is not started within two years after the effective date of this permit, or if construction or modification is suspended for one year or more.

You will be in violation of 10 CSR 10-6.060 if you fail to adhere to the specifications and conditions listed in your application, this permit and the project review. In the event that there is a discrepancy between the permit application and this permit, the conditions of this permit shall take precedence. Specifically, all air contaminant control devices shall be operated and maintained as specified in the application, associated plans and specifications.

You must notify the Department's Air Pollution Control Program of the anticipated date of startup of these air contaminant sources. The information must be made available within 30 days of actual startup. Also, you must notify the Department of Natural Resources' regional office responsible for the area within which you are located within 15 days after the actual startup of these air contaminant sources.

A copy of this permit and permit review shall be kept at the installation address and shall be made available to Department of Natural Resources' personnel upon request.

You may appeal this permit or any of the listed special conditions to the Administrative Hearing Commission (AHC), P.O. Box 1557, Jefferson City, MO 65102, as provided in RSMo 643.075.6 and 621.250.3. If you choose to appeal, you must file a petition with the AHC within 30 days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed. If it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the AHC.

If you choose not to appeal, this certificate, the project review and your application and associated correspondence constitutes your permit to construct. The permit allows you to construct and operate your air contaminant sources(s), but in no way relieves you of your obligation to comply with all applicable provisions of the Missouri Air Conservation Law, regulations of the Missouri Department of Natural Resources and other applicable federal, state and local laws and ordinances.

The Air Pollution Control Program invites your questions regarding this air pollution permit. Please contact the Construction Permit Unit at (573) 751-4817. If you prefer to write, please address your correspondence to the Missouri Department of Natural Resources, Air Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102-0176, attention: Construction Permit Unit.

SPECIAL CONDITIONS:

The permittee is authorized to construct and operate subject to the following special conditions:

The special conditions listed in this permit were included based on the authority granted the Missouri Air Pollution Control Program by the Missouri Air Conservation Law (specifically 643.075) and by the Missouri Rules listed in Title 10, Division 10 of the Code of State Regulations (specifically 10 CSR 10-6.060). For specific details regarding conditions, see 10 CSR 10-6.060 paragraph (12)(A)10. "Conditions required by permitting authority."

Zoltek
St. Charles County (S34, T46N, R3E)

1. VOC Usage Limitation
   A. Zoltek shall process less than 95 Megagrams (Mg) of VOCs in any consecutive 12-month period through EP-12 (resin handling and mixing) in order to be subject only to the monitoring, reporting, and record keeping requirements of 40 CFR 60 Subpart VVV, *Standards of Performance for Polymeric Coating of Supporting Substrates Facilities*.

   B. Attachment A or equivalent forms, such as electronic forms approved by the Air Pollution Control Program, shall be used to demonstrate compliance with Special Condition 1.A.

2. Record Keeping and Reporting Requirements
   A. Zoltek shall maintain all records required by this permit for not less than five years and shall make them available immediately to any Missouri Department of Natural Resources' personnel upon request. These records shall include SDS for all materials used.

   B. Zoltek shall report to the Air Pollution Control Program's Compliance/Enforcement Section, P.O. Box 176, Jefferson City, MO 65102, no later than 10 days after the end of the month during which any record required by this permit shows an exceedance of a limitation imposed by this permit.

REVIEW OF APPLICATION FOR AUTHORITY TO CONSTRUCT AND OPERATE
SECTION (5) REVIEW
Project Number: 2015-06-005
Installation ID Number: 183-0110
Permit Number:

Installation Address:
Zoltek
11 Missouri Research Park Drive
St. Charles, MO 63304
St. Charles County (S34, T46N, R3E)

Parent Company:
Zoltek Corporation
3101 McKelvey Road
Bridgeton, MO 63044

REVIEW SUMMARY

- Zoltek has applied for authority to install two (2) new pultrusion lines and associated support equipment.

- The application was deemed complete on June 9, 2015.

- HAP emissions are expected from the proposed equipment. HAPs of concern from this process include styrene and methyl isobutyl ketone (MIBK).

- 40 CFR 60 Subpart VVV, *Standards of Performance for Polymeric Coating of Supporting Substrates Facilities*, applies to the equipment.

- None of the NESHAPs apply to this installation. None of the currently promulgated MACT regulations apply to the proposed equipment.

- This review was conducted in accordance with Section (5) of Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*. Potential emissions of all criteria pollutants are below de minimis levels.

- This installation is located in St. Charles County, a nonattainment area for the 8-hour ozone standard and the $PM_{2.5}$ standard and an attainment area for all other criteria pollutants.

- This installation is not on the List of Named Installations found in 10 CSR 10-6.020(3)(B), Table 2. The installation's major source level is 250 tons per year and fugitive emissions are not counted toward major source applicability.

- Ambient air quality modeling was performed to determine the ambient impact of styrene.

- Emission testing is not required for the equipment.

- Submittal of an application to amend your Basic Operating Permit is required within 30 days of equipment startup.

- Approval of this permit is recommended with special conditions.

INSTALLATION DESCRIPTION

Zoltek Corporation operates a carbon fiber manufacturing plant in St. Charles County, Missouri. The plant previously produced carbon fiber from polyacrylonitrile (PAN) fibers, but it no longer produces the carbon fiber at the site. Instead, the plant receives carbon fiber spun on individual spools, commonly referred to as carbon tows. The plant also receives carbon fibers woven into a felt material. The tows can be handling in the milling operations where they are chopped into specific length fibers or milled into pellets. The tows can also undergo various conventional textile processes where the fiber is stretched, broken, spun into a yarn, woven or knitted.

After the textile process, the carbon fiber and/or felt material are then carbonized in high temperature furnaces. The temperatures vary from 1,100°C to 2,000°C, depending on the final product specifications. During this heating process, the carbon fibers are under either vacuum or a nitrogen blanket. During the carbonization process, approximately half the weight of the fibers is lost. The resulting product is 97% to 99.9% carbon. The weight loss is the result of the chemical breakdown of the acrylics. The decomposition products form an unpredictable combination of carbon, nitrogen, hydrogen and oxygen. The effluent from the carbonization furnaces goes into a thermal oxidizer. The vacuum pump seal water is also metered into the thermal oxidizer.

When the desired temperature is reached in the furnace, the fibers are held at that temperature for a predetermined period of time. When the batch run is complete, the furnace is cooled until the internals reach 150°C at which time the products are removed from the furnace. After the carbonization process is complete, the products are inspected, then stored or shipped.

This facility is classified as a minor source for construction permitting and currently operates under a Basic Operating Permit, which expires on October 31, 2017. The following New Source Review permits have been issued to Zoltek from the Air Pollution Control Program.

Table 1: Permit History

Permit Number	Description
0191-005	Carbon fiber manufacturing plant
0497-016	Two (2) new batch furnaces
0997-046	Two (2) new batch furnaces and replacement of two (2) thermal oxidizers

PROJECT DESCRIPTION

Zoltek is proposing to install two new carbon fiber pultrusion lines, along with several resin material storage and handling operations. The new pultrusion lines will be used to create carbon fiber blades for wind turbines. The pultrusion process involves the reinforcement of carbon fibers that are impregnated with resin, then pulled through a heated stationary die where it undergoes polymerization. Ancillary equipment to the process will include resin mixers, storage drums, and carbon fiber composite cutting. Each pultrusion line (including cutting) has a maximum production rate of 8.14 board feet per hour, and the resin handling/ mixing process has a maximum design rate of 7.96 gallons per hour.

EMISSIONS/CONTROLS EVALUATION

Emissions from the two pultrusion lines were calculated using material balances for the VOC and HAP containing compounds. Volatile and HAP percentages for each chemical were taken from the respective SDS and multiplied by the maximum design rate of the production lines to find the maximum VOC and HAP usage rates. Volumetric design rates for resin application were measured using a standard length of 1 meter, width of 105 millimeters (mm), and depth of 3 mm, which were then converted to board feet per meter of product. It was assumed that the process has a 93% yield for resin application, which is conservative for the industry, so the remaining 7% VOCs and HAPs are emitted.

Emissions from resin mixing and handling were calculated using the loading loss equation from the EPA document AP-42, *Compilation of Air Pollutant Emission Factors*, Fifth Edition, Section 5.2, *Transportation and Marketing of Petroleum Liquids* (July 2008). It was conservatively assumed that 100% styrene is processed, as a worst-case scenario. A saturation factor of 1.45 was used, which was taken from Table 5.2-1. The vapor pressure and molecular weight of styrene were taken from the SDS, and the temperature was assumed to be 68°F. The calculated emission rate was found to be 0.345 pounds of styrene per 1,000 gallons of material loaded.

Particulate emissions from carbon fiber board cutting were estimated by calculating the cut volume for each cut made. The maximum board pull rate (meters per minute) was used to determine the maximum cutting rate, which was found to be 6.71 cuts per day. The volume of each cut was conservatively estimated to be 1/8 inch wide, on a 300 mm long, 3 mm deep board; this results in a cut volume of $1.01E^{-4}$ cubic feet per cut. Using these values, along with the density of the carbon fiber board, the mass of board lost due to cutting was estimated. It was assumed that 100% of the lost board is emitted as particulate matter and that all particulate is $PM_{2.5}$. Even without control devices, particulate emissions from board cutting are negligible.

The maximum throughput of EP-12 was calculated to be approximately 238 Mg of VOC per year, if 100% styrene is used. By limiting the usage of VOCs through EP-12 to less than 95 Mg per year, all other project processes are bottlenecked and therefore subsequently limited in their emission rates by the same factor.

The following table provides an emissions summary for this project. Existing potential emissions were taken from the operating permit determination under project 2013-07-018. Existing actual emissions were taken from the installation's 2014 EIQ. Potential emissions of the application represent the potential of the new equipment, assuming continuous operation (8,760 hours per year) at the maximum design rate. New installation conditioned potential emissions represent the installation's new potential, while accounting for special condition limitations in this permit.

Table 2: Emissions Summary (tons per year)

Pollutant	Regulatory *De Minimis* Levels / SMAL	Existing Potential Emissions	Existing Actual Emissions (2014 EIQ)	Potential Emissions of the Application	New Installation Conditioned Potential
PM	25.0	0.93	N/D	<0.01	0.93
PM_{10}	15.0	3.40	1.42	<0.01	3.40
$PM_{2.5}$	10.0	3.40	1.42	<0.01	3.40
SO_x	40.0	0.05	N/A	N/A	0.05
NO_x	40.0	51.46	5.36	N/A	51.46
VOC	40.0	8.79	0.28	7.43	11.75
CO	100.0	54.71	0.11	N/A	54.71
Cyanide Compounds	10.0 / 0.1	0.77	N/D	N/A	0.77
Styrene	10.0 / 1	N/D	N/A	7.24	2.88
MIBK[1]	10.0 / 10	N/D	N/A	0.02	0.01
Total HAPs	25.0	0.78	N/A	7.26	3.67

N/A = Not Applicable; N/D = Not Determined
[1] Methyl Isobutyl Ketone

PERMIT RULE APPLICABILITY

This review was conducted in accordance with Section (5) of Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*. Potential emissions of all criteria pollutants are below de minimis levels.

APPLICABLE REQUIREMENTS

Zoltek shall comply with the following applicable requirements. The Missouri Air Conservation Laws and Regulations should be consulted for specific record keeping, monitoring, and reporting requirements. Compliance with these emission standards, based on information submitted in the application, has been verified at the time this application was approved. For a complete list of applicable requirements for your installation, please consult your operating permit.

GENERAL REQUIREMENTS

- *Submission of Emission Data, Emission Fees and Process Information,* 10 CSR 10-6.110

- *Operating Permits*, 10 CSR 10-6.065

- *Restriction of Particulate Matter to the Ambient Air Beyond the Premises of Origin*, 10 CSR 10-6.170

- *Restriction of Emission of Visible Air Contaminants*, 10 CSR 10-6.220

- *Restriction of Emission of Odors*, 10 CSR 10-6.165

SPECIFIC REQUIREMENTS

- *New Source Performance Regulations*, 10 CSR 10-6.070
    - –*Standards of Performance for Polymeric Coating of Supporting Substrates Facilities*, 40 CFR Part 60, Subpart VVV

AMBIENT AIR QUALITY IMPACT ANALYSIS

Ambient air quality modeling was performed to determine the ambient impact of styrene. Conditioned potential styrene emissions are 2.88 tons per year, which exceed the SMAL of 1 ton per year, thus requiring modeling. Modeling was performed using EPA's AERSCREEN. The maximum modeled impact for styrene was found to be much less than the risk assessment levels (RALs) for both the 24-hour and annual averaging times. This means that although the SMAL for styrene is exceeded, at the conditioned potential of 2.88 tons per year emitted, the facility is always expected to be in compliance with the RALs. No further analysis is necessary.

Table 3. Ambient Air Quality Impact Analysis Summary

Pollutant	RAL (µg/m^3)	Averaging Time	Modeled Impact (µg/m^3)	Limited Impact (µg/m^3)
Styrene	2,240	24-hour	199.4	N/A
	333	Annual	33.23	N/A

STAFF RECOMMENDATION

On the basis of this review conducted in accordance with Section (5), Missouri State Rule 10 CSR 10-6.060, *Construction Permits Required*, it is recommended that this permit be granted with special conditions.

PERMIT DOCUMENTS

The following documents are incorporated by reference into this permit:

- The Application for Authority to Construct form, dated May 29, 2015, received June 2, 2015, designating Zoltek Corporation as the owner and operator of the installation.

Attachment A – *VOC Usage Compliance Worksheet

Zoltek
St. Charles County (S34, T46N, R3E)
Project Number: 2015-06-005
Installation ID Number: 183-0110
Permit Number: _____

This sheet covers the month of _____ in the year _____

A	B	C	D	E	F
Chemical Used in EP-12	**Amount Used (gallons)**	**[1]Specific Gravity**	**[2]Volatile Percent**	**[3]VOC Usage (tons)**	**[4]VOC Usage (Mg)**
Ex. Corrolite® 31038-00	*2,000*	*1.06*	*48.0%*	*4.25*	*3.85*
G			**[5]Total Monthly VOC Usage (Mg) for EP-12:**		
H			**[6]Previous 11-Months VOC Usage (Mg) for EP-12:**		
I			**[7]Current 12-Month VOC Usage (Mg) for EP-12:**		

* All “VOCs” shall meet the state/ federal definition of a volatile organic compound.
[1] Specific Gravity shall be taken from the SDS. If a range is given, use the highest value listed.
[2] Volatile Percent shall be taken from the SDS. If a range is given, use the highest value listed.
[3] VOC Usage (tons) is calculated using the following equation: [E] = [B] x [C] x (8.345 lb/gal) x [D] ÷ (2,000 lb/ton)
[4] VOC Usage (Mg) is calculated using the following equation: [F] = [E] x (0.907 Mg/ton)
[5] Total Monthly VOC Usage (Mg) is calculated by adding up all the values in [F]
[6] Previous 11-Months VOC Usage is calculated by adding [G] on Attachment A for the previous 11 months.
[7] Current 12-Month VOC Usage is calculated using the following equation: [I] = [G] + [H]

A Current 12-Month VOC Usage of less than 95 Mg for EP-12 indicates compliance.

APPENDIX A

Abbreviations and Acronyms

% ..... percent
ºF ..... degrees Fahrenheit
acfm ..... actual cubic feet per minute
BACT ..... Best Available Control Technology
BMPs ..... Best Management Practices
Btu..... British thermal unit
CAM ..... Compliance Assurance Monitoring
CAS..... Chemical Abstracts Service
CEMS ..... Continuous Emission Monitor System
CFR ..... Code of Federal Regulations
CO ..... carbon monoxide
CO_2..... carbon dioxide
CO_2e..... carbon dioxide equivalent
COMS..... Continuous Opacity Monitoring System
CSR..... Code of State Regulations
dscf ..... dry standard cubic feet
EIQ ..... Emission Inventory Questionnaire
EP..... Emission Point
EPA ..... Environmental Protection Agency
EU..... Emission Unit
fps ..... feet per second
ft ..... feet
GACT ..... Generally Available Control Technology
GHG ..... Greenhouse Gas
gpm..... gallons per minute
gr..... grains
GWP..... Global Warming Potential
HAP..... Hazardous Air Pollutant
hr..... hour
hp ..... horsepower
lb ..... pound
lbs/hr..... pounds per hour
MACT ..... Maximum Achievable Control Technology
$\mu g/m^3$..... micrograms per cubic meter
m/s ..... meters per second
Mgal ..... 1,000 gallons
MW ..... megawatt
MHDR..... maximum hourly design rate
MMBtu.... Million British thermal units
MMCF..... million cubic feet
MSDS ..... Material Safety Data Sheet
NAAQS... National Ambient Air Quality Standards
NESHAPs National Emissions Standards for Hazardous Air Pollutants
NO_x..... nitrogen oxides
NSPS..... New Source Performance Standards
NSR..... New Source Review
PM ..... particulate matter
$PM_{2.5}$..... particulate matter less than 2.5 microns in aerodynamic diameter
PM_{10}..... particulate matter less than 10 microns in aerodynamic diameter
ppm..... parts per million
PSD ..... Prevention of Significant Deterioration
PTE..... potential to emit
RACT..... Reasonable Available Control Technology
RAL ..... Risk Assessment Level
SCC..... Source Classification Code
scfm ..... standard cubic feet per minute
SDS ..... Safety Data Sheet
SIC..... Standard Industrial Classification
SIP..... State Implementation Plan
SMAL ..... Screening Model Action Levels
SO_x..... sulfur oxides
SO_2..... sulfur dioxide
tph..... tons per hour
tpy ..... tons per year
VMT..... vehicle miles traveled
VOC..... Volatile Organic Compound

Mr. Brian Butler
Corporate EHS Manager
Zoltek
3101 McKelvey Road
Bridgeton, MO 63044

RE: New Source Review Permit - Project Number: 2015-06-005

Dear Mr. Butler:

Enclosed with this letter is your permit to construct. Please study it carefully and refer to Appendix A for a list of common abbreviations and acronyms used in the permit. Also, note the special conditions on the accompanying pages. The document entitled, "Review of Application for Authority to Construct," is part of the permit and should be kept with this permit in your files. Operation in accordance with these conditions, your new source review permit application and with your amended operating permit is necessary for continued compliance. The reverse side of your permit certificate has important information concerning standard permit conditions and your rights and obligations under the laws and regulations of the State of Missouri.

If you were adversely affected by this permit decision, you may be entitled to pursue an appeal before the administrative hearing commission pursuant to Sections 621.250 and 643.075.6 RSMo. To appeal, you must file a petition with the administrative hearing commission within thirty days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by: Administrative Hearing Commission, Truman State Office Building, P.O. Box 1557, Jefferson City, MO 65102, www.oa.mo.gov/ahc.

If you have any questions regarding this permit, contact Ryan Schott, at the Department of Natural Resources' Air Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102 or at (573) 751-4817.

Sincerely,

AIR POLLUTION CONTROL PROGRAM

Susan Heckenkamp
New Source Review Unit Chief

SH:rsl

Enclosures

c: St. Louis Regional Office
PAMS File: 2015-06-005

Permit Number: