STATEMENT OF BASIS

For the issuance of Draft Air Permit # 1290-AOP-R2 AFIN: 04-00313

1. PERMITTING AUTHORITY:

   Division of Environmental Quality
   5301 Northshore Drive
   North Little Rock, Arkansas 72118-5317

2. APPLICANT:

   Hendren Plastics, Inc.
   1607 Highway 72 SE
   Gravette, Arkansas 72736

3. PERMIT WRITER:

   Bart Patton

4. NAICS DESCRIPTION AND CODE:

   NAICS Description: Polystyrene Foam Product Manufacturing
   NAICS Code: 326140

5. ALL SUBMITTALS:

   The following is a list of ALL permit applications included in this permit revision.

Date of Application	Type of Application (New, Renewal, Modification, Deminimis/Minor Mod, or Administrative Amendment)	Short Description of Any Changes That Would Be Considered New or Modified Emissions
8/11/2020	Renewal	N/A

6. REVIEWER'S NOTES:

   Hendren Plastics, Inc., located in Gravette, AR, operates a polystyrene foam molding plant.

At this revision, the facility renewed its Title V permit. The following changes were made:

- Specific Conditions, Plantwide Conditions, General Provisions and the Insignificant Activities sections were updated to the current standard wording.
- Plantwide Condition #7 and General Provision #27 were added because they are part of the current standard conditions, not because of any modifications requested as part of this revision.
- Specific Condition #3 was deleted because it is not currently part of the standard conditions used in Title V Permits.
- The process of hot wire cutting of EPS (expanded polystyrene foam) was evaluated for emissions at this R2 revision, but no emissions or conditions were changed.

Emissions at this revision were unchanged.

7. COMPLIANCE STATUS:

The following summarizes the current compliance of the facility including active/pending enforcement actions and recent compliance activities and issues.

The facility has no current or pending enforcement issues.

8. PSD/GHG APPLICABILITY:

a) Did the facility undergo PSD review in this permit (i.e., BACT, Modeling, etc.)? N
If yes, were GHG emission increases significant? N/A

b) Is the facility categorized as a major source for PSD? N

- *Single pollutant ≥ 100 tpy and on the list of 28 or single pollutant ≥ 250 tpy and not on list*

9. SOURCE AND POLLUTANT SPECIFIC REGULATORY APPLICABILITY:

Source	Pollutant	Regulation (NSPS, NESHAP or PSD)
None		

Two natural gas-fired boilers (150 hp and 175 hp) are classified as Category A-1 (Fuel Burning Equipment) Insignificant Activities. At this R2 renewal, they were re-evaluated for NESHAP 6J (area source boiler MACT) and are not subject to the subpart because they are natural gas-fired boilers under the definition of a gas-fired boiler found in 40 C.F.R. §63.11237.

10. UNCONSTRUCTED SOURCES:

Unconstructed Source	Permit Approval Date	Extension Requested Date	Extension Approval Date	If Greater than 18 Months without Approval, List Reason for Continued Inclusion in Permit
None				

11. PERMIT SHIELD – TITLE V PERMITS ONLY:

Did the facility request a permit shield in this application? N

12. COMPLIANCE ASSURANCE MONITORING (CAM) – TITLE V PERMITS ONLY:

N/A.

13. EMISSION CHANGES AND FEE CALCULATION:

See emission change and fee calculation spreadsheet in Appendix A.

14. AMBIENT AIR EVALUATIONS:

The following are results for ambient air evaluations or modeling.

a) NAAQS

A NAAQS evaluation is not required under the Arkansas State Implementation Plan, National Ambient Air Quality Standards, Infrastructure SIPs and NAAQS SIP per Ark. Code Ann. § 8-4-318, dated March 2017 and the DEQ Air Permit Screening Modeling Instructions.

b) Non-Criteria Pollutants:

Based on Division of Environmental Quality procedures for review of non-criteria pollutants, emissions of non-criteria pollutants are below thresholds of concern.

c) No other modeling was required.

15. CALCULATIONS:

SN	Emission Factor Source (AP-42, testing, etc.)	Emission Factor (lb/ton, lb/hr, etc.)	Control Equipment	Control Equipment Efficiency	Comments
01	VOC material balance	7% pentane content, 100% loss assumed	N/A	N/A	Assumes all pentane is released from material during expansion, molding, storage, and fabrication.

Evaluation of Hot Wire Cutting Process

Rule 26.102 states, "Permits issued under this program will address all applicable air contaminant emissions and regulatory requirements in a single document." To address all applicable air contaminant emissions, the available information must be evaluated, and scientific and engineering judgment must be used. In this revision, the Arkansas DEQ Office of Air Quality (OAQ) evaluated the hot wire cutting process and elected not to include emissions of air contaminants besides pentane (as a VOC) at this time.

Hot Wire Cutting process

The facility uses hot wire cutting to shape expanded polystyrene foam, a standard industry practice. In the previous Arkansas air permits for this facility, this was treated as a strictly mechanical cutting process. It was not considered that the heat used in this process might cause thermal decomposition on the cut surfaces of the EPS, leading to air emissions besides the pentane emissions already accounted for in the permit.

Hot wire cutting is a process in which an electrical current is sent through a wire, typically made of the nickel and chrome alloy NiChrome, to heat it. The heated wire is moved across or through a foam, such as expanded polystyrene (EPS) or extruded polystyrene (XPS), to slice or shape the foam as desired. Modern industrial hot wire cutting equipment may be large and may be computer numerically controlled, but smaller, simpler sets are made for home use by hobbyists. While there are differences between industrial equipment and home equipment, both types make contact between a heated wire and a foam such as EPS, and given similar materials to cut, the same kinds of pollutants would likely be emitted. Home hobbyist sets are not stringently regulated and, given reasonable ventilation, are not usually considered dangerous.

Regulatory Approach by EPA and Other States

Based on a survey of permits from other states, permits that regulate the hot wire cutting of EPS usually include emissions of VOCs, specifically pentane, but not emissions of

HAPs or other air contaminants from this process, even emissions that might be expected based on the composition of EPS, such as styrene and BETX (benzene, ethylbenzene, toluene, and xylene).

EPA's AP-42 does not include emission factors to calculate emissions from this process. No relevant NESHAP has been issued.

A few permits were found that included HAP emissions from hot wire cutting of EPS, but they did not suggest a clear, well-substantiated method to calculate these emissions. Minnesota's Pollution Control Agency issued a draft permit in 2020 for Minnesota Diversified Products—West (MDPW) in Rockford, Minnesota, Permit No. 17100085-101. The permit's technical support document calculates EPS hot wire cutting emissions by treating the cutting process as similar to combustion, and the polystyrene material as similar to No. 6 fuel oil. Only the amount of EPS to be cut (vaporized) was used in the calculation, and an amount of No. 6 fuel oil with the same heat content as that amount of EPS was used. For a facility roughly similar to Hendren Plastics in overall throughput potential (225 tpy VOC potential to emit vs. Hendren Plastics' 237 tpy), MDPW's total HAP emissions from hot wire cutting were calculated at 1.59E-03 tpy, or 3.18 pounds per year, by this method. However, when properly performed, hot wire cutting should not result in combustion, and expanded polystyrene has many differences from No. 6 fuel oil, a dense, viscous liquid now mostly used as marine fuel because its sulfur content tends to corrode industrial equipment. While it is likely that the assumptions to compare this process to combustion of No. 6 fuel oil presented a much worse case for emissions than the actual process in most respects, there was a lack of substantiation for why those assumptions should be made.

Oregon's Department of Environmental Quality issued a permit for Jeld-Wen in Chiloquin, Oregon, in 2012, permit number 18-0089-ST-01. In the 2018 review report viewable online, HAP emissions from hot wire cutting of EPS are included. Oregon DEQ responded to a request from Arkansas OAQ for the source of their emission factors but was unable to supply that information before the draft permit for Hendren Plastics was issued.

It is not clear that most permitting authorities are considering the potential for emissions from hot wire cutting of EPS. This, rather than a lack of emissions, may be why so few permits include these emissions. (A phone conversation with a permit engineer from another state working with a facility that used hot wire cutting of EPS indicated that other emissions had not been considered when the permit was originally issued, and may not have been considered during numerous Title V renewals either.) It is also possible that the potential emissions are not being included because they would be very small.

Scientific Research

In an article supplied by the facility, Seleem et al describe the thermal decomposition of EPS as part of a comparison between polystyrene and bio-based polymer aerogels, to show the comparable safety of bio-based polymer aerogels. Drawing from the article, the facility's consultant states, "Onset of degradation of the foam is at 325 degrees C or 617 deg F. The temperature range for the Nichrome hot wire cutters used at Hendren Plastics is 300-450 degrees F. The EPS does not reach a temperature that would cause HAPs to be emitted."

We agree that Seleem makes the statement quoted above, but that seems to be lacking context. In the article, Seleem states that the onset temperatures and the degradation products in their experiment were consistent with prior literature reports (53, 59). They cited Gurman et al, 1987, an article that surveyed dozens of experiments. Gurman found thermal decomposition of polystyrene at temperatures as low as 200 C, with 1% mass volatilized at 224 C (below 450 F / 232 C), within the temperature range used by the facility. Seleem's experimental goal seems to be to make a comparison, not determine when decomposition begins, and Seleem's article does not dispute Gurman's findings.

Seleem and other researchers have used laboratory pyrolysis (placing a test sample in a chamber with heated gas) to take measurements under controlled conditions of convection. Hot wire cutting, on the other hand, uses conductive heat transfer. Hathcock et al found similarities (and differences) in the decomposition products of EPS depending on whether pyrolysis or hot wire cutting was used, but he notes on page 656 that laboratory pyrolysis depends on "experimental variables which are difficult to control." He also states that pyrolysis "is highly dependent on equipment and conditions. The modeling of pyrolysis processes that occur in an industrial environment is therefore rather difficult...Additional difficulties arise in field work, because the concentration of volatiles is usually very low. It is important to have an adequate concentration of substances to obtain spectra of good quality." Aside from the difference in experimental intent, the experiment by Seleem may have differed from other experiments in some other parameter that increased the temperature for onset of degradation.

Industrial Hygiene Research

OAQ's evaluation also looked at two studies based on field measurements.

A 2006 study by NIOSH measured a variety of air contaminants at a facility in Wisconsin that expanded and cut polystyrene foam. They stated, "NIOSH investigators conclude that a health hazard did not exist on the day of this evaluation. Employees were not exposed over applicable occupations exposure limits to carbon monoxide, pentane, styrene, acetophenone, ethylbenzene, xylene, respirable dust, or total dust while molding and cutting EPS products."

A 2017 study by Aura Health & Safety Corporation measured air contaminants from hot wire cutting of EPS, specifically at sites making theatrical staging. They were hindered by a limited amount of material throughput during their observation period. They made the following conclusions: "The results suggest that the hot-wire foam cutting workers and nearby bystanders are not at a risk of over exposure to fume generated by this task under conditions similar to those present during this assessment. It should be stated that even if exposure levels are well below applicable OELs, odour thresholds may be breached, hence presenting a nuisance, or perception of a health hazard, to workers. It is recommended that additional sampling be performed during varied environmental conditions and volumes of foam cutting in order to attain enough exposure data to perform statistical analysis common in the practice of industrial hygiene."

The Aura study also notes that they did not consider the variety of air contaminants that NIOSH considered. Our evaluation has focused on HAPs, namely styrene and BETX. We have not given the same level of consideration to other pollutants that may be present, such as other HAPs, particulate from brominated fire retardants, particulate matter in general, and carbon monoxide. It was difficult to find quantitative data for the few HAPs we were most concerned about, and that data was not sufficient to make a good calculations--data about other possible pollutants was even more scarce.

Conclusion

From this evaluation, we draw the following conclusions:

1) There is evidence that hot wire cutting of EPS produces air contaminants in addition to pentane.
2) Given ventilation and good work practices, industry and the industrial hygiene community do not consider the emissions from hot wire cutting of EPS to pose a serious health threat, but they do expect emissions to be present.
3) There is not a clear method for how to calculate these emissions accurately, besides pentane.
4) Most air permits for the relevant facilities do not include these emissions, besides pentane.
5) If the method of calculation used by Minnesota PCA were found to be appropriate and applied to this facility at its permitted throughput, the HAPs emitted would be on the order of 10 pounds per year, not 100 or 1000 pounds per year, and they would be similar to HAPs from fuel combustion, plus styrene.

We recommend that this issue be revisited at a later revision, when more data and a clearer regulatory consensus may exist.

References Cited:

Gurman, J.; Baier, L.; Levin, B. Polystyrenes: A Review of the Literature on the Products of Thermal Decomposition and Toxicity. Fire and Materials 1987, 11, 109-130.

Hathcock, Stanley, L.; Bertsch, Wolfgang. Analysis of Volatiles Associated with Industrial Scale Processing of Expanded Polystyrene, Part I: Methods Development. Journal of High Resolution Chromatography October 1993, 16, 609-614.

Hathcock, Stanley, L.; Bertsch, Wolfgang. Analysis of Volatiles Associated with Industrial Scale Processing of Expanded Polystyrene, Part II: Identification and Quantitation. Journal of High Resolution Chromatography November 1993, 16, 651-659.

Minnesota Pollution Control Agency. Minnesota Air Emission Permit No. 17100085-101, Technical Support Document, MDP West Calculations, page 6 of 9.

National Institute for Occupational Safety and Health (NIOSH), Hazard Evaluation and Technical Assistance Branch. NIOSH Health Hazard Evaluation Report, HETA #2005-0243-3016, ACH Foam Technologies, Fond du Lac, Wisconsin. September 2006.

Oregon Department of Environmental Quality. Standard Air Contaminant Discharge Permit, Review Report, permit number 18-0089-ST-01, 2018.

Seleem, S.; Hopkins, M.; Olivio, J.; Schiraldi, D.A. Comparison of thermal decomposition of polystyrene products vs. bio-based polymer aerogels. Ohio J. Sci. 2017,117, 50–60.

16. TESTING REQUIREMENTS:

The permit requires testing of the following sources.

SN	Pollutants	Test Method	Test Interval	Justification
None				

17. MONITORING OR CEMS:

The permittee must monitor the following parameters with CEMS or other monitoring equipment (temperature, pressure differential, etc.)

SN	Parameter or Pollutant to be Monitored	Method (CEM, Pressure Gauge, etc.)	Frequency	Report (Y/N)
N/A				

18. RECORDKEEPING REQUIREMENTS:

The following are items (such as throughput, fuel usage, VOC content, etc.) that must be tracked and recorded.

SN	Recorded Item	Permit Limit	Frequency	Report (Y/N)
Facility	VOC	237 tons/year	Monthly	N
Facility	Expandable Polystyrene Resins	7% Pentane Content	Monthly	N

19. OPACITY:

SN	Opacity	Justification for limit	Compliance Mechanism
N/A			

20. DELETED CONDITIONS:

Former SC	Justification for removal
3	Condition was brought over when this permit went from minor source to Title V, and is not currently in the Title V permit template

21. GROUP A INSIGNIFICANT ACTIVITIES:

The following is a list of Insignificant Activities including revisions by this permit.

Source Name	Group A Category	Emissions (tpy)						
		PM/PM_{10}	SO_2	VOC	CO	NO_x	HAPs	
							Single	Total
150-hp (heat input) boiler	A-1	0.012	0.001	0.009	0.138	0.164		0.003
175-hp (heat input) boiler	A-1	0.015	0.001	0.011	0.161	0.191		0.004
A-1 Total		0.027	0.002	0.020	0.299	0.355		0.007

22. VOIDED, SUPERSEDED, OR SUBSUMED PERMITS:

The following is a list of all active permits voided/superseded/subsumed by the issuance of this permit.

Permit #
1290-AOP-R1

APPENDIX A – EMISSION CHANGES AND FEE CALCULATION

Fee Calculation for Major Source

Revised 03-11-16

Facility Name: Hendren Plastics, Inc.
Permit Number: 1290-AOP-R2
AFIN: 04-00313

$/ton factor	23.93	Annual Chargeable Emissions (tpy)	237
Permit Type	Renewal No Changes	Permit Fee $	0

Minor Modification Fee $	500
Minimum Modification Fee $	1000
Renewal with Minor Modification $	500
Check if Facility Holds an Active Minor Source or Minor Source General Permit	☐
If Hold Active Permit, Amt of Last Annual Air Permit Invoice $	0
Total Permit Fee Chargeable Emissions (tpy)	0
Initial Title V Permit Fee Chargeable Emissions (tpy)	

HAPs not included in VOC or PM: *Chlorine, Hydrazine, HCl, HF, Methyl Chloroform, Methylene Chloride, Phosphine, Tetrachloroethylene, Titanium Tetrachloride*

Air Contaminants: *All air contaminants are chargeable unless they are included in other totals (e.g., H2SO4 in condensible PM, H2S in TRS, etc.)*

Pollutant (tpy)	Check if Chargeable Emission	Old Permit	New Permit	Change in Emissions	Permit Fee Chargeable Emissions	Annual Chargeable Emissions
PM		0	0	0		
PM_{10}		0	0	0	0	0
$PM_{2.5}$		0	0	0		
SO_2		0	0	0	0	0
VOC		237	237	0	0	237
CO		0	0	0		
NO_X		0	0	0	0	0